73 Amateur Radio Today

JUNE 1993
ISSUE #393
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International Edition

PC BOARD LAYOUT TIPS

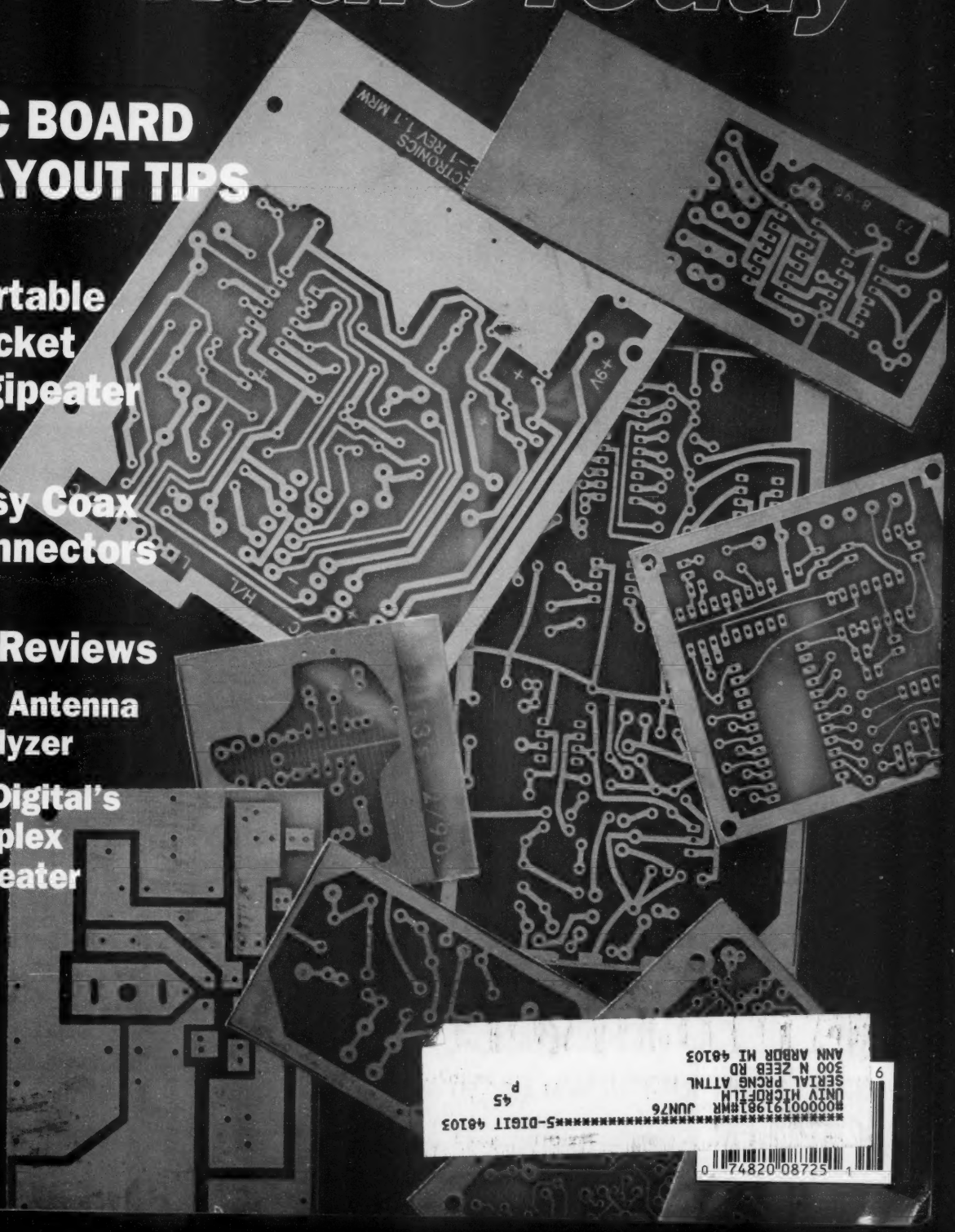
Portable Packet Digipeater

Easy Coax Connectors

73 Reviews

MFJ Antenna Analyzer

US Digital's Simplex Repeater



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Choose Your Mobile In 3 Easy Steps:

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Today's most popular band, the best place for new hams to meet old hands, learn good operating procedures. Very friendly, thousands of open repeaters & autopatches everywhere. Great for on/off-the-road help. Crowded, though, especially in cities. Single-band mobile is easy to learn & use. No-Code friendly!

440 MHz

Next most popular band, less crowded with more high-tech, "smart" repeaters offering autopatch, remote base, linking, digital-voice recording. Some are limited-access (PL). Allows crossband repeating between singleband handhelds & dualband mobiles. 440 gives access to advanced technical info. This is where the pros hang out! No-Code friendly!

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IC-229H 2 Meters

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IC-449H 440MHz

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IC-38A 220MHz

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IC-1201 1.2 GHz

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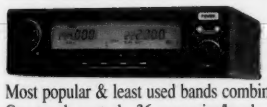
IC-2410A/H 2 Meter/440MHz

Same functions as IC-3230, plus ParaWatch for receiving 2 signals on same band simultaneously.

IC-2330A/H 2 Meter/220 MH



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C	***TA-90-L*** Telescope elbow antenna	16.
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G	***M-207-IC*** Interface cable for MFJ-207	10.
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ITC	SA1800	$1895.00	1 - 1800MHZ	80dB	-110dBm	10HZ*	YES	YES	YES	YES	500MHZ**
B&K	2610	$2895.00	1 - 1000MHZ	70dB	-92dBm	1MHZ	NO	NO	NO	NO	2MHZ
PROTECK	P-7802	$3500.00	1 - 1000MHZ	70dB	-92dBm	1MHZ	NO	NO	NO	NO	2MHZ
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CIRCLE 112 ON READER SERVICE CARD

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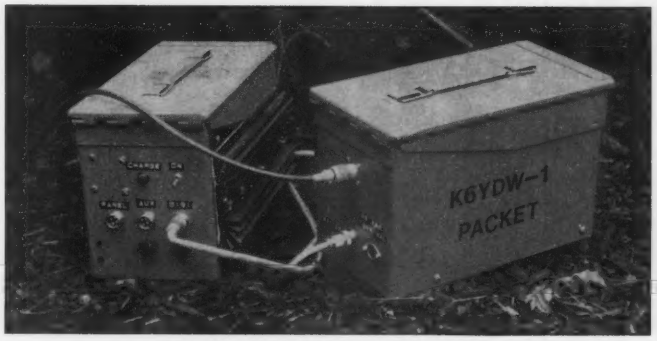

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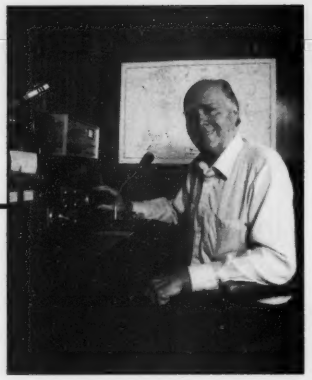
Contract: The mere glancing at this fine print has just made you legally and morally bound to an agreement with the staff and management of *73* to spread the word. Since you like *73* so much, don't you think one or two of your closest ham buddies might enjoy it, too? Go out and get just one other ham to give us a try.

NEVER SAY DIE

Wayne Green W2NSD/1



Another Extra Class Convicted!

Of course it's just coincidence that the hams who have been arrested and convicted of crimes have all been Extra Class. We all know how bad the language on CB can get. Well, two people have been arrested and convicted for the outstanding use of foul language on CB and both were Extra Class hams. Now I see that NS3K has been arrested for transmitting false distress signals on 14.313.

So much for the baloney about Morse code keeping the riffraff out of our hobby. More likely it's keeping out good guys, otherwise we'd be seeing some of our thousands of no-code Techs getting into trouble.

Now, for you knee-jerk liberals, I'm not putting down the code as a fun aspect of the hobby. It only seems to help unbalance a small percentage of us, so it's probably a reasonable trade-off. I believe NS3K might be able to make a good defense if he pleads that the Morse code so scrambled his brain that he was unable to function within accepted limits.

And I'm not saying that all Extra Class hams are crazy. Not all. But I'd sure like to hear from any Extras who think they can round up at least three non-hams who know them and who will attest to their possible sanity. I don't expect much mail.

Did KV4FZ Poison 14.313?

There is strong evidence that 14.313 has been infected with a debilitating virus for which no known cure has yet been discovered. There seems little question but that Herb Schoenbohm KV4FZ is the ham responsible for releasing the virus. He is, by the way, an Extra Class ham. You've probably read about his conviction for phone service theft.

Almost everyone who tunes up on 14.313 seems to come down with the virus. The best bet is to not even listen to the frequency. Perhaps Dick Whiten WB2OTK can get his $10,500 fine for jamming 14.313 reduced if he pleads temporary insanity caused by Herb's virus.

If the FCC is actually able to collect anything on fines for outstandingly bad operating on 14.313, they may have a new source of revenue which could significantly help the Treasury balance off some of the pork barrel waste we can't stop our congressmen from passing into law. Sock it to 'em, Charlie.

Wayne Green Fails Again — Totally!

It's almost enough to discourage someone . . . at least someone not afflicted with a Never Say Die complex. No doubt a genetic mishap. I'm talking (well, writing, actually) about my abysmal failure to get you to keep notes when you buy a new piece of ham gear and let me know how it does for you. I want to know about any problems you have; any successes; how much fun it is; and so on.

I happen to know you're buying ham gear. I know you're buying new transceivers, new antennas, stuff for packet, RTTY, and so on. What I don't know is how much trouble you've had getting it going. I don't know what modifications you've cooked up. I don't know how your dealer has done in helping you, or how the manufacturer has been about helping you. I'm not up here in an ivory tower in New Hampshire, so let me know what's going on.

Other than the usual crapola on 14.313, what frustrations have you with the hobby? Look, we don't have a part of the ham exams designed to eliminate the insane, so we're going to have to deal with a level of fruitcakes. As I've explained, our school system guarantees that we'll have a disturbingly high percentage of people who are uncreative, angry, subservient, and prone to religious causes such as environmentalism.

Worse, there's more than enough evidence to convince me that there's a real possibility that the Morse code itself may be contributing significantly to unbalancing those without a tight grip on reality. I wish the ARRL would cooperate with researchers in fields like this, but of course, as a true-blue dedicated CW organization, I can understand their reluctance to let this can of worms be opened.

We don't know how much the code damages us via just hearing it, and how much may be due to the sharp square-wave pulses of high energy RF from our linears. I guess the best approach is just to deny the whole thing and not worry about it, and to heck with the research already done. Scientists are always being proven wrong, right? Just remember a short while back to the nuclear winter, acid rain, ozone depletion, and carbon dioxide panics. Oh yes, and Alar. And weren't we running out of oil pretty soon?

A Ton of Reviews

If you're interested in buying a new piece of ham gear, you sure want to know what you're getting into before you run up your MasterCard account. That means you want to check out a product review. Well, guess which ham rag has the most reviews? And has 'em first? You probably guessed.

In 1992 we ran 33 reviews, and not one of these products was reviewed in *CQ* or *QST* before we published ours. Not one! Heck, we beat *QST* on the AEA FSTV system by 21 months, the Ameritron linear by 10 months, the Command Tech 2m linear by 19 months, and so on. How about the Drake R8? We beat 'em by 16 and 17 months on that one! These are supposed to be new equipment reviews, not old equipment reviews. The other two magazines reviewed only 25 products each in 1992.

If you've got the background and enjoy writing, you can do worse than volunteer to do new product reviews for us. The prestige is awesome; the pay sucks.

I started off asking for you to let me know your reaction to anything new you've bought. This holds even more for kits. I've had a couple grumbles about some kits, but then I've gotten enthusiastic letters from others about the same kits. If you put together a kit please let me know how it does for you. I want to know if it's a good bargain. Does it do what it claims?

In these days when parts for building are almost impossible to find and circuit boards are full of ICs, we're very dependent on kits for our building fun. Having spent many years at the workbench and still having a bunch of my old homemade stuff out in the barn, I want to do all I can to help newcomers to the hobby to find out how much fun it is to build stuff. I'd love to knock together some kits, but every time I start to buy one I get honest with myself. I look at my desk, with a stack of unanswered mail. I look at the homework I need to do to put out my *Declare War Update* newsletters for the New Hampshire Economic Development Commission and our legislature. Sigh. Plus, I want to get to Dayton for a couple days, and I have talks scheduled with a growing number of chambers of commerce and Rotary Clubs. So, I tell you what, I'll do my Don Quixote bit, railing against the political windmills, and you put the kits together and let me know how they've done for you.

Cellular and Cancer

As a radio expert you're expected to be able to advise people on how serious this cancer business is for people using cellular telephones. I like the statement by a Motorola researcher that he would not use one for more than 30 minutes a day.

Yes, there is a lot more to be learned, but that doesn't mean that there isn't convincing evidence of the connection. The weasel-words are that we don't yet know how this happens. That's the same excuse the tobacco companies' paid scientists are using to say they've not yet seen evidence that convinces them of the tobacco-cancer connection. If I were being paid as much as they are I'd probably have trouble being convinced too.

If you've kept up with Ross Adey (K6UI) and his experiments, you know he's proven a connection between 450 MHz RF and cell growth changes. We're still learning about how cells work and how they communicate. There are both chemical and electric communications, either (or both) of which could be affected by magnetic or radio fields. There could even be other communications systems.

If you watched the PBS program on sharks you know that some species of sharks can track fish by their electric fields . . . and this is in salt water! Now, if this system is built into sharks, which have been around for hundreds of millions of years, we might want to find out more about how this works and see if something similar is at work in our bodies.

One thing that has really upset researchers is the incredibly low field strength of low frequency magnetic fields which can cause cellular changes. These fields are far more destructive than ever imagined.

With RF it may turn out to be more the modulating frequencies which are detected by our cells than any effects from the RF itself. This is why a couple years ago I suggested that we not put HTs to our head when PL tones are being used. Until Ross and the other top researchers in this field prove that RF is harmless, you have little to lose by considering it a potential danger and keeping your head away from RF. Heck, keep your whole body away from it.

I've been joking . . . sort of . . . about how CW operators are crazier than the rest of us. Well, there's some reason to believe that high-powered RF and power line magnetic fields from a CW-keyed rig just might screw up our cells beyond the ability of our system to self-

Continued on page 80

3 MORE REASONS TO BUY AZDEN- 2, 6 & 10 METER HANDHELDS!

Now, for the first time, Azden handhelds are available in the U.S., and you can buy them directly from the factory. This means that you will receive the level of knowledge and expertise that you want when buying a radio.
We also have in-house competent technicians, ready to handle your service needs–quickly and efficiently!
Don't forget–all Azden radios come with a 2 YEAR LIMITED WARRANTY.
These great new Azden handhelds all feature:

- Rugged commercial construction
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- Includes all functions

Other features include:

- Two level power out (5 and .5 watts)
- True FM modulation
- Double conversion receiver
- Sensitivity <Ø.16 uV for 12 dB SINAD
- Audio output .25 watts
- 41 memories in two banks
- All CTCSS tones (encode & decode)
- DTMF paging & Code Squelch
- 7 DTMF telephone memory Receives aircraft band (AZ-21A only)
- Scan memory skip
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- Battery power saver
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- Weatherproof speaker microphone, SDX-514W
- External DC power cord, AD-16

2 Meter model AZ-21A
RX 118 - 135.995 MHz AM
136 - 174 MHz FM
TX 144 - 147.995 MHz FM
(CAP & MARS with permit)

10 Meter model AZ-11
RX 28 - 29.995 MHz FM
TX 28 - 29.7 MHz FM

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RX 46 - 54 MHz FM
TX 50 - 54 MHz FM

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LETTERS

From the Hamshack

Klaus Spies WB9YBM, Niles IL Wayne, as one who wants to be an entrepreneur, I thought it's about time I came out of the closet to agree with all of those times you tried to motivate everyone in your "Never Say Die" column. You're right: We should get our fannies in gear, do what we enjoy, and make a living at it. You've set the example with your undertakings.

I've never been certain of what to start an entrpreneurship in (problem number one), and (problem number two) after getting laid off from a job of nine and a half years (as an engineering technician for Motorola), I've been banging my head against the wall trying to figure out how to go about putting into practice what you've been talking about all these years.

Have you thought about writing a "How-To" book for entrepreneurs who want to start an entrepreneurship? (Doing an entrepreneurship on a limited budget would be a topic I'd like to learn more about, too!) You can put my name on top of the list of those wanting to buy a copy. I'll also be willing to bet that if you print this in *73*'s "Letters" column there'll be a bunch of people out there who'll beat your door down for their own copies of this book!

Ron Koyich VS6BD, Hong Kong Way to go, Wayne! Thank you for another excellent editorial, this one in the January 1993 issue, on health and child-rearing. I feel badly about not giving more thought to the subject before I had a child. Hopefully it will benefit the unborn of those parents-to-be who read it. Maybe not, though, when you consider how many young people do things without much consideration of the consequences. I know I did.

It's never too late to change our attitudes, however, and to embark on a journey of learning more about ourselves. Your editorials have no doubt had some influence on me—for that I thank you.

On the subject of health, a book that my wife and I have enjoyed is *Perfect Health* by Dr. Deepak Chopra. It explores mind/body connections.

Bob Brobst WB9UOF, Alexandria IN In case you get the feeling that no one reads your articles, I want to let you know that I enjoy your controversial editorials. I wish your comments on electrical hazards around us had been published earlier as our daughter-in-law recently lost her premature daughter, very likely due to complications from her computer use of eight to 10 hours a day as a sales rep. Keep up the good work in bringing information to us in a method that makes us think and search for more information on our own, even when many times we don't feel like we have the time to spare.

Bob, I've been warning about magnetic fields for several years now. You must have missed some of my editorials . . . Wayne

William B. Maddock WAØAIZ, Florissant MO Regarding your March "NSD" column: Aha! I can't believe that an intelligent American in 1993 still believes that the Japanese really surprised Roosevelt or that U. S. military intelligence let the country down. I worked as an intercept radio operator and cryptographer and I worked with men who were assigned to the Naval Intelligence Unit at Pearl Harbor. The Intelligence Unit did its job! On December 1, 1941, the entire Imperial Japanese Fleet in the South China Sea changed callsigns and codes. Also, in the ensuing week, the biggest Japanese secret regarding the attack was masterfully put together by Naval Intelligence at Pearl Harbor. The secret: One flotilla was to observe strict radio silence—the flotilla which attacked Pearl Harbor. This flotilla complied to the letter. Not a peep or key click out of them.

Our guys out-foxed this plan and within three days a complete callsign matrix was reconstructed from transmissions made by the rest of the fleet. One flotilla was missing. Conclusion: This flotilla was the one sent to attack the U.S. Almost at the same time a spy was caught noting berthing information at Pearl Harbor (which everyone conceded would be the target anyway, if war came). Condensation of the above: One week before the attack, experts in the field of Communications Intelligence saw what they knew, given the situation between Japan and the U.S., i.e. the callsign and code change at the same time could mean only one thing—war, and war in a very short time. WASHINGTON WAS NOTIFIED BY TOP SECRET MESSAGE. Also, every commanding officer in the Pacific was notified. Three days later, confirmation that an entire war-strength flotilla had broken off from the main fleet and had maintained total radio silence. WASHINGTON AND PACIFIC COMMANDERS WERE UPDATED. During this week, with no reply from Washington, General Short, Army Commanding General in Hawaii, made several significant steps to prepare for attack, including relocation of most of the B-17 bombers to other airfields and airstrips in the Hawaiian islands to avoid concentration of these valuable long-range bombers. (Had he not done this, there wouldn't have been enough recon capability to find the ships which bombed Hawaii.) Admiral Kimmel, the Naval Commander, permitted all the ships to steam right into their berths at Pearl Harbor as they had done for months. They all came into Pearl Harbor every weekend! Kimmel apparently didn't take any action to protect anything. He apparently had no confidence in Naval Intelligence. Both General Short and Admiral Kimmel were relieved immediately and retired from active duty shortly after the war started—and spent their remaining years in disgrace.

Linda KJ5FC and Dan N5UNU, Brenham TX We visited your boat (*USS Drum* in Mobile, Alabama) and read as much as we could of your newsletters. It was hard to read with so many folks coming through. We wish you a great year in '93—lots more good editorials and much more success with *Radio Fun*.

Thanks for the note, Linda and Dan. It was fun writing about our adventures during the war on the Drum, *and publishing the stories in the* Drum Newsletter. *I probably should have made copies available to interested hams, but it just didn't occur to me . . . Wayne*

Joseph Lively KJ5FS, Fort Worth TX Wayne, I must take some exception to your negative assessment of the "service" value of ham radio. I know that a large percentage of what one hears on the bands is far from service-oriented, but in this part of the country the SKYWARN nets on 2 meters perform a valuable service. Last weekend I attended a "SKYWARN School" and have just sent in my application to join RACES so that I can participate. I don't know about you, but large hail and tornadoes scare the #$%&! out of me, and I like to be able to keep track of that stuff!

I hope you're wrong concerning the deleterious effects of magnetic fields; it seems like it's getting to where *everything* is bad for one's health. I think a lot of hams use a lot more power than they need to; many of them on 75 meters use 1500 watts to rag-chew when they could go barefoot and communicate just fine. I am in the process of setting up an HF station, and it'll be barefoot by necessity for some time! I hope the high-power guys don't blow me into the weeds. I don't care whether I'm "30 over S9" or not—I just want to be able to get through decently. It seems to me that if fewer people were so power hungry, there would be fewer strong magnetic fields for them to worry about. After all, the FCC regs state that one should use the minimum amount of power necessary.

Erling A. Gruel WB9OJD, Fond du Lac WI I've been a subscriber/reader off and on since the mid '70s when I got my first ham ticket. I got onto 2 meter FM, and thought repeaters were the best thing to happen to ham radio . . . little did I know. In the last several years, I've kept seeing packet radio editorial comments in your columns, and just couldn't picture myself using a computer to communicate with other hams. Part of the problems was that I didn't really understand computers and the jargon very well . . . and was a bit afraid of it, too!

After one-too-many Wayne packet rantings, I got brave. I thought: Oh well, why not try it? So I assembled a budget computer system that everyone could laugh at (and some did!). For about $200 I got an old Commodore 128, a couple of 1541 disk drives, a parallel interface (did I say that?), and an Epson 9-dot matrix printer. Then I really did it—for Christmas I had the wife give me an MFJ packet circuit card to fit into the back of the 128. Cheap, yes . . . but it works!

WOW! What a different world in ham radio! Yeah, I made mistakes (still do!), but I found my touch-typing handy here! After 40 or so days on the air, it's a real challenge, it's interesting, and it's FUN!

As a sideline, I learned more about computers than I thought I could, and now I even use the system for other things, like assembling frequency lists for my scanner radio from research into FCC records. Makes nice copy, and I don't have to have a lot of paper lying around . . . the whole thing is stored on disk until I download it to the printer! (Sounds like jargon to me.)

I always say, "You never get a 'bum steer' from Wayne!"

Dave Kaiser AL7HG, Dhahran, Saudi Arabia I have just received the January issue. You asked, why don't some hams get involved in packet? In my case, my interest in ham radio is as a rag-chewer and in getting to talk to a lot of different people in a lot of different places.

I am a sometimes DXer; I collect DX cards when I happen to run across one. I've averaged 10 cards a year since becoming a ham, and I probably got a lot of those during my first several years as a ham, and less since (perhaps due to better band conditions back in the '60s). If I were an avid DXer and interested in obtaining cards with the help of a DX association repeater, I might invest in packet, but I'm not THAT much of a DXer.

I presume many hams work in computer-related fields. I stare at a computer screen all day; I sure don't want to come home and do the same thing as a hobby.

In my opinion, the new law limiting scanner frequencies is TERRIBLE. We have technology available to do a lot of things, and hams have a license that theoretically permits them to use it, and yet it's possible for a self-interested group (cellular interests) to sneak through a law that has long-range effects on everyone. Many third world countries prohibit ham radio transmissions and the sale of ANY scanners. Is that next?

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FEATURES:
- **Very low noise:** 0.7dB vhf, 0.8dB uhf
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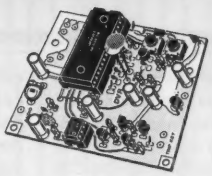
Low noise converters to receive vhf and uhf bands on a 10M receiver.
- **Kit less case *$49*, kit w/case & BNC jacks *$74*, w&t in case *$99*.**
- Input ranges avail: 50-52, 136-138, 144-146, 145-147, 146-148, 220-222, 222-224 MHz, 432-434, 435-437, 435.5-437.5, and 439.25 (to chan 3).

TRANSMITTING CONVERTERS

XV2 for vhf and XV4 for uhf. Models to convert 10M ssb, cw, fm, etc. to 2M, 220, 222, 432, 435, and atv. 1W output. ***Kit only $89.*** PA's up to 45W available.

ACCESSORIES



NEW DVR-1 DIGITAL VOICE RECORDER Module. Primarily a **voice ID'er for repeaters**. May also be used as a **contest CQ caller** or as a **"radio notepad"** to record up to 20 seconds of received transmissions for instant recall. As a **repeater ID'er,** it will record your voice, using either the built-in microphone or an external mic. It can be used with almost any repeater COR module. As a **contest caller,** you can record a message or even several messages and play them through your transmitter at the press of a switch. As a **radio notepad,** you can keep it wired to the audio output of a receiver ready to record up to 20 seconds of anything you might want to recall later. Play it back as many times as you like through a small external speaker. (Call for more information.) .....kit $89, w&t $139

TD-3 SUBAUDIBLE TONE DECODER/ENCODER. Adjustable for any tone. Designed **especially for repeaters,** with remote control activate/deactivate provisions ....kit $29, wired & tested $69

COR-3 REPEATER CONTROLLER. Features adjustable tail and time-out timers, solid-state relay, courtesy beep, and local speaker amplifier ..... kit $49

CWID. Diode programmed any time in the field, adjustable tone, speed, and timer, to go with COR-3 ..... kit $59

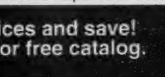
COR-4. Complete COR and CWID all on one board for easy construction. CMOS logic for low power consumption. Many new features. EPROM programmed; specify call ..... kit $99, w&t $159

TD-2 TOUCH-TONE DECODER/CONTROLLER. Full 16 digits, with toll-call restrictor, programmable. Can turn 5 functions on/off. Great for selective calling, too! .....kit $89, wired & tested $149

NEW TD-4 SELECTIVE CALLING Module. Economy touch-tone decoder with 1 latching output. Primarily designed to mute speaker until someone calls you by sending 4-digit tt signal but may also be used to turn on autopatch or other device..... kit $49, w&t $89

AP-3 AUTOPATCH. Use with above for repeater autopatch. Reverse patch and phone line remote control are std. .....kit $89, wired & tested $149

AP-2 SIMPLEX AUTOPATCH Timing Board. Use with above for simplex operation using a transceiver ..... kit $39



MO-202 FSK DATA MODULATOR. Run up to 1200 baud digital signals through any fm transmitter with full handshakes. Radio link computers, telemetry gear, etc. ..... kit $49, w&t $79

DE-202 FSK DEMODULATOR. For receive end of link. ..... kit $49, w&t $79

9600 BAUD DIGITAL RF LINKS. Low-cost packet networking system, consisting of MO-96 Modem and special versions of our 144, 220 or 450 MHz FM Transmitters and Receivers. Interface directly with most TNC's. Fast, diode-switched PA's output 15 or 50W.

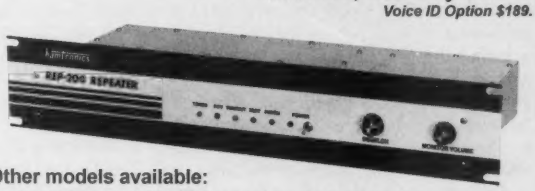
NEW **Real-Speech Voice ID Option Available With DVR-1 Digital Voice Recorder Shown At Left!**

REP-200 REPEATER

A microprocessor-controlled repeater with autopatch and many versatile dtmf control features at less than you might pay for a bare-bones repeater or controller alone!

We don't skimp on rf modules, either! Check the features on R144 Receiver below, for instance: GaAs FET front-end, helical resonators, sharp crystal filters, hysteresis squelch.

Kit $1095; w&t only $1295!
Voice ID Option $189.



Other models available:

REP-200V Economy Repeater. As above, except uses COR-4 Controller without DTMF control or autopatch. **Kit only $795.**

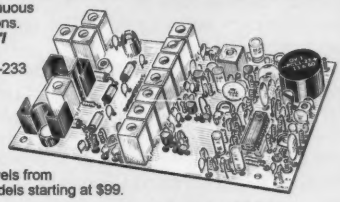
REP-200N Repeater with no controller. For use with external controller, such as those made by ACC. **Kit only $695, w&t $995.**

- Available for the 50-54, 143-174, 213-233, 420-475, 902-928 MHz bands.
- *FCC type accepted for commercial service (hi-band and uhf).*
- **Rugged exciter and PA**, designed for continuous duty.
- Power out 20W 50-54MHz; 15W (25W option avail.) 143-174MHz; 15W 213-233 MHz; 10W uhf; 10W 902-928MHz.
- Available add-on PA's **up to 100W.**
- **Six courtesy beep types**, including two pleasant multi-tone bursts.
- **Open or closed access autopatch, toll-call restrict**, auto-disconnect.
- **Reverse Autopatch,** two types: auto-answer or ring tone on the air.
- Pulse (rotary) dial option available.
- **DTMF CONTROL:** over 45 functions can be controlled by dtmf command. 4-digit control code for each function.
- **Owner can inhibit** autopatch or repeater, enable either open or closed access for repeater or autopatch, and enable toll calls, reverse patch, kerchunk filter, site alarm, aux rcvr, and other options.
- Cw speed and tone, beep delay, tail timer, and courtesy beep type **can be changed at any time** by owner password protected dtmf commands.
- **Auxiliary receiver input** for control or **cross linking repeaters.**
- Many **built-in diagnostic** and testing functions using microprocessor.
- Color coded **LED's indicate status** of all major functions.
- **Welded rf-tight partitions** for exciter, pa, receiver, and controller.
- 3½ inch aluminum rack panel, finished in eggshell white and black.

XMTRS & RCVRS FOR REPEATERS, AUDIO & DIGITAL LINKS, TELEMETRY, ETC.

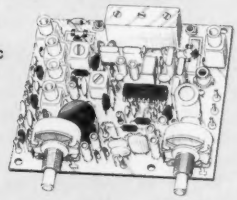
Also available in rf-tight enclosures, and with data modems.

FM EXCITERS: 2W continuous duty. TCXO & xtal oven options. ***FCC type accepted for com'l high band & uhf.***



- **TA51**: 50-54, 143-174, 213-233 MHz ...kit $109, w&t $189.
- **TA451**: 420-475 MHz ...kit $109, w&t $189.
- **TA901**: 902-928 MHz, (0.5W out); w&t $219.
- **VHF & UHF AMPLIFIERS.**
- For fm, ssb, atv. Output levels from 10W to 100W. Several models starting at $99.

FM RECEIVERS:



- **R144/R220 FM RECEIVERS** for 143-174 or 213-233 MHz. **GaAs FET** front end, 0.15uV sensitivity! Both crystal & ceramic if filters plus **helical resonator** front end for exceptional selectivity: >100dB at ±12kHz (best available anywhere!) Flutter-proof hysteresis squelch; afc tracks drift. ...kit $149, w&t $219.
- **R451 FM RCVR,** for 420-475 MHz. Similar to above. ...kit $149, w&t $219.
- **R901 FM RCVR,** for 902-928MHz. Triple-conversion, GaAs FET front end. ...$169, w&t $249.
- **R76 ECONOMY FM RCVR** for 28-30, 50-54, 73-76, 143-174, 213-233 MHz, w/o helical res or afc. ...Kits $129, w&t $219.
- **R137 WEATHER SATELLITE RCVR** for 137 MHz. Kit $129, w&t $219.

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Domino's Pizza Delivery Driver Summons Assistance with Ham Radio

Only two days after receiving his ham radio license, Store 7036 driver Doug Graham KB7RKY used his newly-acquired skill to summon help to the accident scene he had just discovered.

Being the first on the scene, Graham jumped out of his vehicle and immediately investigated the wreckage for injured bodies. Relieved that there were no visible life-threatening injuries, Graham quickly and professionally used his amateur radio to call for help.

After following the standard emergency procedure for ham radio operators—calling "break, break, break"—Graham finally heard back from someone offering assistance.

"I put out a call to any ham radio operator in the Louiston/Clarkston valley for help," said Graham. "And then another ham operator (Betty Drinnon N7IPU) came back. She said, "KB7RKY, how can I be of assistance?"

After asking her to call the sheriff's department and Rescue One, Graham then moved his own car out of the roadway and began directing traffic around the accident. *Reprinted from the March 5, 1993 "Pepperoni Press," the newsletter for Domino's Pizza.*

FCC Proposes Ham Band Spectrum Sharing

Three FCC Public Notices were recently issued underscoring the fact that we as amateurs should get used to the idea of sharing spectrum with other services. Actually, most VHF and higher frequency spectrum is shared. The three news items that the FCC released concern the 1.25 meter, 70 cm and 33 cm ham bands.

Until August 1991, the Amateur Service had access to the entire 220 to 225 MHz band on a secondary basis. The FCC separated this shared spectrum into two exclusive segments. The primary reason given was to accommodate new narrowband technology which would not be compatible with amateur operations.

The Land Mobile Service got the 220-222 MHz portion for narrowband business radio. Ham radio was allocated the remaining three megahertz, 222-225 MHz. The biggest loss was at 220.5 to 221.9 MHz, which amateurs used for control links.

The FCC received more than 550 requests in 1991 asking that they review the 220-222 MHz reallocation. In response to these *Petitions for Reconsideration*, the FCC said they thought that in certain areas of the country, some relief was indeed justified. They said the Commission would entertain a request for replacement spectrum and asked the ARRL to make a specific proposal showing how amateur operations could use shared spectrum without causing interference to existing users.

After considerable amateur and professional testing, the ARRL filed a petition with the FCC. They asked for access to 216 to 220 MHz on a shared basis to " . . . provide reaccommodation for . . . present and future wideband date intercity links and other point-to-point fixed amateur stations . . . displaced from the 220-222 MHz band." The ARRL said it was not possible to relocate displaced data operations at 222-225 MHz due to the existence of extensive 1.25 meter repeater networks.

The 216 to 220 MHz band is primarily allocated in the United States to the Maritime Mobile Service. The *Automated Maritime Telecommunications System* (AMTS) operates 80 channels on this spectrum. To reduce interference, the League agreed that amateur activity at 216 to 220 MHz should be managed. A power level of 50 watts was suggested, as well as specific frequency coordination. On March 5th, the FCC released a bulletin stating that it would adopt a *Notice of Proposed Rule Making* to provide " . . . a secondary allocation for the Amateur Service in the 219 to 220 MHz band to be used for amateur auxiliary station (point-to-point) packet backbone networks and other amateur point-to-point fixed communications."

The Commission also recommended operating limits and other measures to ensure that these amateur operations do not cause interference to primary operations in and adjacent to the 219-220 MHz band. We will not know the extent of these controls until the exact text of the NPRM is issued.

On March 10th, the FCC proposed to allocate the 449 MHz band for wind profiler radar systems (sensitive pulsed radars that measure wind speed and direction at altitudes between 1,500 and 53,000 feet) and asked the public whether they should be accommodated in the 915 MHz (ISM) band as well. This really was not a surprise since the government has been investigating several VHF and UHF homes for wind profilers for several years now.

The first thing that comes to mind to most of us is that 420 to 450 MHz is allocated to the Amateur Service. Does this mean that the Amateur Service is losing access to more spectrum? The answer is no! We must remember that amateur radio uses the 70 cm ham band on a secondary basis. What it does mean is that we will be gaining another sharing partner.

The primary user of the 420-450 MHz band is Government Radiolocation. Government frequencies are assigned by the NTIA (National Telecommunications and Information Administration) and not the FCC.

The good news is that the impact on the Amateur Service should be minimal. Wind profiler radars are generally located in remote rural locations and not near the 30-mile radius of most 70 cm repeaters located in population centers. Furthermore, the government has agreed to take whatever steps they can to minimize the impact of wind profilers on existing amateur repeater users, and installation of the wind profiler network is not expected to begin for another five to 10 years. That will allow plenty of time for repeater owners and wind profiler planners to determine what steps need to be taken to minimize interference to one another.

The 33 cm ham band at 902-928 MHz is lightly used by the Amateur Service. Theoretically, FM repeaters are supposed to be operating on the band with inputs at 906-909 MHz, matched with 918-921 outputs. Amateur TV and packet operation also have extensive ham band-planning at 33 cm. For the most part, however, 902-928 MHz is not used by the ham community.

Internationally, the 33 cm band is allocated to the Fixed Service on a primary basis, with Amateur, Mobile and Radiolocation secondary. The pecking order is slightly different in the United States where the primary users are Government Radiolocation and ISM (Industrial, Scientific and Medical) use. ISM bands are often referred to as "junk" bands since they provide a home for almost any device that radiates energy. Even microwave ovens cook on 915 MHz.

On March 11th, the FCC said they would be permanently allocating shared use of 902-928 MHz to Automatic Vehicle Monitoring (AVM) systems (used to locate and track vehicles using non-voice methods, and to relay information to and from vehicles). The FCC proposed to expand the service to encompass location of all objects, animate and inanimate, and to allow licensees to provide service on a private carrier basis to individuals, the federal government and business band users.

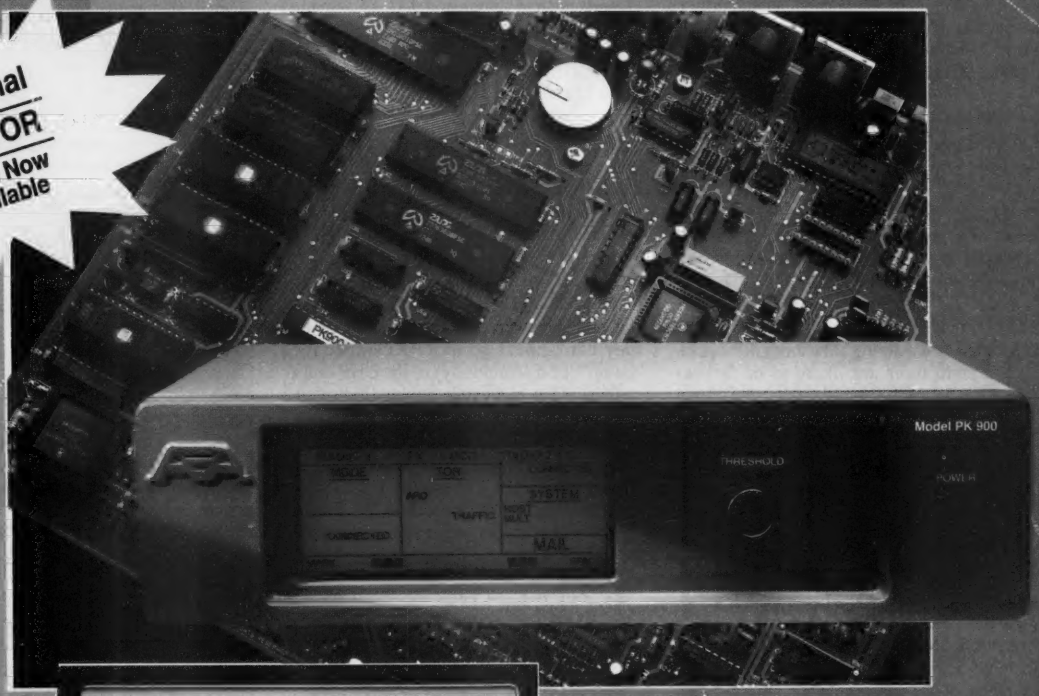
The AVM Service will be renamed the *Location and Monitoring Service* (LMS) which the FCC defines as the use of non-voice signaling methods from and to radio units to make known the location of such units.

The FCC suggested that wideband LMS systems be licensed on the 904-912 and 918-926 MHz bands and narrowband LMS systems at 902-904, 912-918 and 926-928 MHz. The Commission believes that wideband systems are capable of operating in a shared environment, but asked if there is a need to provide spectrum exclusively for some period of time.

Sharing our spectrum with other radio services and the U.S. government is covered in the Amateur Service Part 97 rules at section 97.303. Since the Amateur Service is a secondary user of all UHF and higher frequency spectrum, we simply have to accept any interference that might be generated by those services designated as primary and we must not interfere with their operation. *TNX W5YI Report, Vol. 15, Issue #7, April 1, 1993.* 73

INTRODUCING THE PK-900... NEW FROM THE INSIDE OUT!

Optional PACTOR Mode Now Available



IT'S THE NEXT GENERATION IN MULTI-MODE CONTROLLERS.

Now, there's a new standard of excellence in multi-mode digital controllers...the new PK-900 from AEA. It incorporates all of the features which made the PK-232 the most popular multi-mode controller in the industry. But that's just the start. AEA's new PK-900 also features dual port HF or VHF on either port; low cost 9600 baud plug-in option; memory ARQ and VHF DCD state machine circuit; powerful triple processor system; zero crossing detector for the sharpest Gray Scale FAX you've ever seen; and many other new software selectable features.

Inside and out, the new PK-900 from AEA is what other multi-mode controllers will now be measured against.

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The Ubiquitous Coaxial Connector

by Steve Katz WB2WIK/6

Connectors . . . can't live with 'em, can't live without 'em. Coaxial connectors, especially, are a real bugaboo for many hams faced with the challenge of installing them in a proper, professional manner and trying to keep the weather elements out of them for any length of time.

Fear not! Coaxial connectors are truly easy to install properly—it just takes the right tools and training (like any job). Luckily, the right tools are likely to be in your own toolbox, or at least at the local discount hardware store. Let's start with the most popular connector in amateur use for 1.8 through 220 MHz, the "UHF" type PL-259.

PL-259 "UHF" Connectors

PL-259 "UHF" connectors are so named because way back when they were invented, any frequency above 100 MHz was considered to be Ultra High. These were the frequencies of our earliest radar systems, and little work had ever been done, except by pioneering experimenters, above this frequency range. Since that time, we have redefined our spectrum to divide it up in "decade" (factors of 10) ranges, and UHF is now defined as 300 through 3,000 MHz. ("VHF," the next decade range below, is defined as 30 through 300 MHz; "SHF," the next decade range above, is defined as 3,000 through 30,000 MHz; etc.).

In any case, UHF connectors are badly misnamed because they really don't work at all well in the real UHF spectrum and their use should be confined to the MF (medium frequency), HF (high frequency, or 3-30 MHz) and VHF ranges. The reason PL-259s work so poorly at Ultra High frequencies is that they are not constant-impedance devices and their physical dimensions are such that they can appear as quite an impedance "bump" (or discontinuity) in the UHF range.

This bump can cause attenuation, which of course is normally undesirable, so PL-259s are best used in the frequency ranges where their impedance discontinuity will be of no consequence. (The bump is created by loose mechanical tolerances in the PL-259 connector design, as well as by variations in the dielectric materials used, construction by different manufacturers, and so forth.)

So, now that we know where we should be using UHF connectors—or at least where their inadequacies can be tolerated—let's install one on a cable.

The PL-259 is designed to accommodate coaxial cables measuring 0.405" outside diameter, like RG8A/U, RG213/U, etc. The rear (cable-entry) end of the connector *body* has internal threads which allow the connector to be literally screwed onto the mating cable's jacket, making a secure mechanical connection prior to any soldering operations. If you have been installing PL-259s *without* screwing the connector body onto the cable jacket, you've been doing it wrong, and the results can be devastating to prolonged performance.

PL-259s can also be modified to accommodate the smaller-diameter cables, like RG58/U (and A/U, C/U, etc.), RG59/U and RG8X (or RG8M) "mini-8" cables. This modification involves using the correct "reducer" size, type UG175/U for RG58 and UG176/U for RG59 or RG8X, which is screwed into the rear end of the connector body as part of the assembly operation, and prior to any soldering. Whether using the larger-size cables (0.405" o.d.) or the smaller-size cables (which are 0.195" or 0.242" respectively), the rear-end internal threads in the connector body are *always* used.

UHF connectors are available in a variety of construction materials and finishes, but the essential dimensions should always be the same. Popular finishes include bright nickel ("Astroplate" from Amphenol, for example), silver plate, and gold flash. Popular dielectric materials include Rexolite, Phenolic and Teflon. Combinations of plating finishes can be found in a single connector. I find the easiest ones to work with are silver-plated (at least the *body* should be silver-plated, if not the connector shell), with Teflon dielectric. The reason for this is that

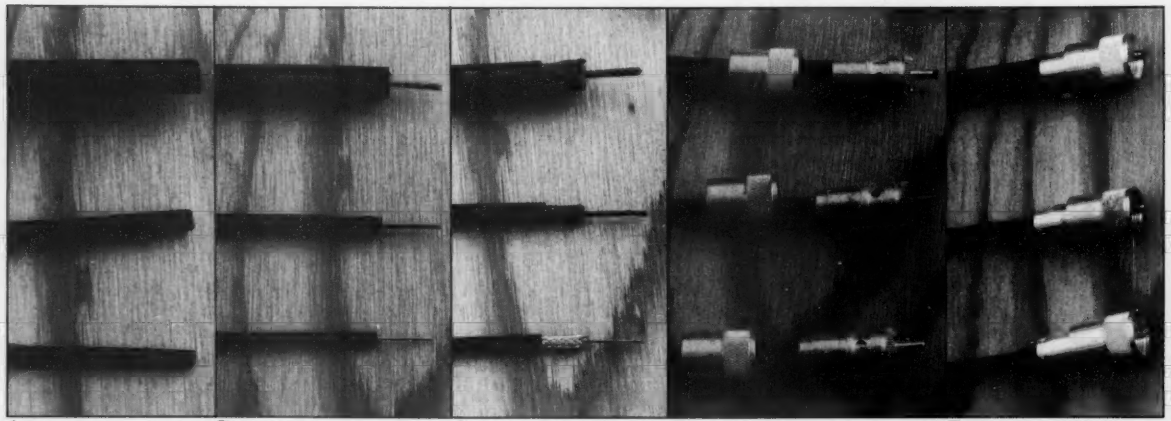
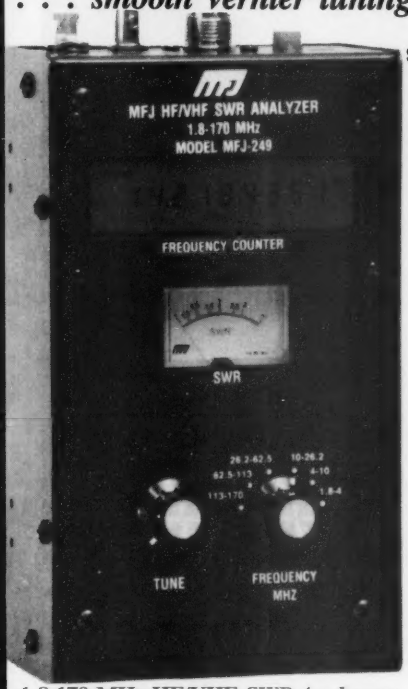


Photo 1.

MFJ *HF/VHF* SWR Analyzer™

. . . covers 1.8-170 MHz continously . . . built-in 10 digit LCD frequency counter . . . smooth vernier tuning . . .



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You get *three* instruments in one . . . a low distortion RF signal generator . . . a sensitive high accuracy 170 MHz frequency counter . . . an *SWR Analyzer*™

Has BNC connector for use as high accuracy frequency counter. Counter has four gate times, .1 Hz resolution, 1 ppm 10 MHz crystal time base with adjustable calibration.

Use 6 AA cells or 110 VAC with MFJ-1312B, $12.95 4x2½x6¾ inches.

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Same as MFJ-249 without LCD frequency counter. Has jack for external frequency counter. Use 6 AA cells or 110 VAC with MFJ-1312B, $12.95. 4x2½x6¾ inches.

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MFJ-203 **$99.95** **The** MFJ-203 is a sensitive *Bandswitched Dip Meter*™ that covers all hams bands from 160-10 Meters. There are no plug-in tuning coils to keep up with or break.

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Just plug in your coax to find the SWR of any HF antenna on any ham band 10-160 Meters. Has jack for external frequency counter. Use 9 volt battery or 110 VAC with MFJ-1312B, $12.95. 7½x2½x2¼ inches.

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MFJ-205 **$89.95** **Need** to measure the feedpoint resistance of your antenna at its resonant frequency?

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It's great for designing impedance matching networks for your antenna.

Reads up to 500 ohms RF resistance and covers all ham bands 160-10 Meters.

With a *conventional* antenna bridge you have to constantly alternate between adjusting the null and frequency controls until you find the best null.

Has jack for external frequency counter. Can be used as an RF signal generator. 7½x 2½x2¼ inches. Use 9 volt battery or 110 VAC with MFJ-1312B, $12.95.

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MFJ-208 **$79.95** **MFJ-208** 2 Meter VHF *SWR Analyzer*™ finds the SWR of any antenna from 138-156 MHz.

Jack for external frequency counter. Use 9 volt battery or 110 VAC with MFJ-1312B, $12.95. 7½x2½x2¼ inches.

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CIRCLE 86 ON READER SERVICE CARD

the silver-plated body accepts soldering at a lower temperature than nickel-plated connectors will, making the soldering operation a much easier job; and the Teflon dielectric will withstand soldering heat better, and be less hydroscopic (will absorb moisture less easily) than other materials. The silver-plated Teflon-dielectric connectors cost a bit more than other constructions, but I find they're usually worth the small amount extra.

Installation

To do a professional job in the installation of a PL-259, you'll need an X-acto knife or a sharp single-edged razor blade (sold in wallpaper/paint shops for a few cents each in boxes of 24 or so), a sharp pair of scissors, similar to manicuring scissors (available in stainless steel for about $5), and a heavy-duty soldering iron, usually a "gun," rated at 260 watts or more, like the Weller D550 or equivalent. It doesn't pay to try using a smaller soldering gun because the heat transfer to the connector will take too long and can cause damage to the cable. If you can't heat up the connector body to the solder-melting point (about 230 degrees C for standard 60/40 alloy solder) in just a few seconds, you're taking too long and will be frustrated. You'll also need some rosin-core solder, usually 60/40 (tin/lead ratio) or 63/37 alloy, 0.047" or 0.050" diameter. The most expensive item here is the big soldering gun, which could cost as much as $50 or so if you don't already own one.

Prepare to work on a *non-metallic* surface because a metal surface will act as a heat sink and draw heat away from the connector so rapidly that soldering will become a difficult task. I do most of my PL-259 soldering on a slab of ceramic (like a large piece of ceramic tile from a bathroom, kitchen or foyer floor—available for free as "scrap" or "sample" from most flooring shops). Ceramic is an excellent material because it will withstand very high temperatures without burning and is a lousy heat sink.

Prepare the cable end for installation of the PL-259 as follows:

(1) Slide the connector "shell" or "nut" over the end of the cable, with its internal threads facing towards the cable end, and push it far enough down the length of cable so that it's out of the way.

(2) Use the razor blade to cut all the way through the cable jacket, braid, and dielectric materials, stopping at the copper center conductor (you can feel it when you hit this obstacle), using vigorous pressure at first to cut through the braid, then lighter pressure as you slice through the dielectric. Don't use so much force that you cut into the center conductor with the blade. If, after you're done, inspection reveals that you *have* cut into the center conductor a bit, cut off and discard this piece of cable and chalk it up to experience, then try again. With a bit of practice it is easy to know how much pressure to use and to stop applying pressure as soon as the blade touches the center conductor. Perform this operation at 5/8" (0.625") from the end of the cable. Once you've successfully sliced through in one spot, hold the razor blade in a fixed position with one hand and rotate the cable 360 degrees so that it cuts in a similar manner all the way around the cable.

(3) When you're done, pull off the piece you've just sliced through, exposing 5/8" of undamaged center conductor (Photo 1B).

(4) Now use the razor blade to slice through *only* the cable jacket, which will not offer much resistance to penetration at all. Do *not* use enough force to cut into the braid material. Make this cut another 5/8" down the cable, or 1-1/4" from the end of the copper center conductor. Rotate the cable 360 degrees again, this time slicing through only the outer jacket material. When you're done, pull off the jacket material you've just sliced through, exposing 5/8" of nice, undamaged braid material (Photo 1C).

(5) Inspect the exposed cable end to be sure no braid "hairs" protrude beyond the freshly-cut dielectric material, risking short-circuiting to the center conductor. With practice, you'll find there won't be any hairs, especially if you use a new, sharp razor blade. If any braid hairs protrude beyond the dielectric and look like they might short circuit to the center conductor, use the small, sharp scissors to cut them off, one by one.

(6) Now, line up the connector body with the end of the prepared cable so that the center conductor will center itself with the 0.150" diameter center pin of the plug. If your coax has a stranded center conductor, inspect the strands to make sure they are tightly wound together, with no "rogues" sticking out. If any strands *are* sticking out, gently twist them back together by spiraling *in the same direction* as they already were in the fresh coax, making a neat, tight bundle for the center pin.

(7) Next, begin inserting the connector body onto the prepared cable end, twisting the body clockwise as you push gently on it. You'll find that within a very short distance the internal threads in the rear end of the connector body will "grab" the jacket material and bite into it quite well, resisting the rotation. Continue to gently push on the connector, while rotating it clockwise, until the cable is firmly "seated" inside the connector and no further progress can be made. At this point the center conductor should protrude slightly (about 1/8") from the end of the center pin hole (Photo 1D).

(8) Now you're ready to solder! The cable braid should be showing through all four PL-259 body "holes," which are there precisely for soldering. Place the connector down on your soldering surface with one body hole straight up, and place a gentle weight on the cable a few inches away from the connector to hold it in place. A heavy book is a good weight. Don't clamp the cable in a vise or anything that can crimp it too hard. Coax is fragile stuff. Pull the trigger on your soldering gun, and wait a few seconds for the tip to heat up to soldering temperature, which will usually be indicated by a bit of smoke coming from the tip. Holding the solder in the other hand, apply the gun's tip to the connector body, right over the soldering hole, and hold it firmly in place for a few seconds to allow the connector to heat up. Now apply a small amount of solder to the joint between the iron's tip and the connector body, and wait a few seconds for it to flow. Once the solder has flowed, move the iron's tip just a small distance (maybe 1/16") out of the way so the connector hole and braid are exposed, and feed the solder right into the hole. Wait another few seconds for the solder to flow into the hole and completely cover the braid and the hole. When the solder has flowed properly it will look bright and shiny, even after you pull the iron away.

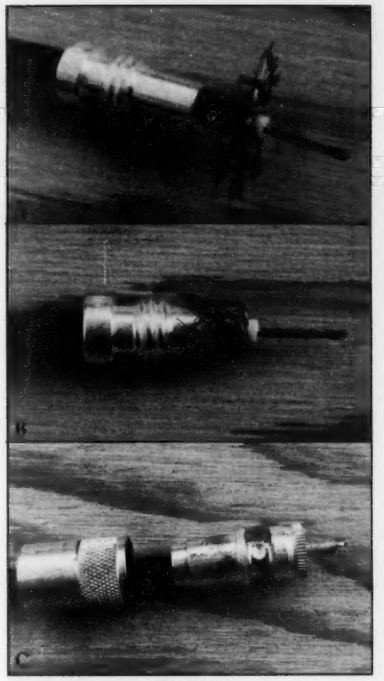

Photo 2.

(9) Now, rotate the connector 90 degrees and do the same thing in the next solder hole. This one will go much faster because the connector is already very hot. So hot, in fact, that you could burn yourself on it if you're not careful. (Some might want to use heat-insulating gloves for this whole operation to help prevent minor burns.)

The second solder hole should fill up in just two to three seconds. Now, rotate the connector body 90 degrees again and do the same thing in the third solder hole. Again, this should happen very fast because the connector is already at soldering temperature. Then, rotate 90 degrees again, and fill up the last solder hole with solder.

If you're doing it right, the whole soldering operation should take maybe 30 seconds or so. If it's taking longer than this, it's taking too long and one of the following might be occurring:

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Gain & Wave:
146 MHz 8.5dB 5/8 wave x 3
446 MHz 11.9dB 5/8 wave x 8
Max Power: 200 watts
Length: 17' 8"
Connector: SO-239

CA-2x4MX
Dual-Band 146/446MHz
Gain & Wave:
146MHz 6.5dB 5/8 wave x 2
446MHz 9.0dB 5/8 wave x 5
Max Power: 200 watts
Length: 10' 2"
Connector: SO-239

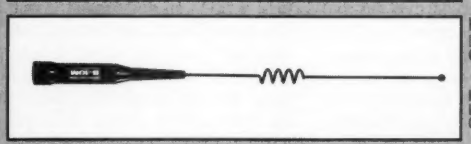
CA-2x4FX
Dual-Band 146/446MHz
Gain:
146MHz 4.5dB
446MHz 7.2dB
Max Power: 200 watts
Length: 5' 11"
Connector: SO-239

COMET™ DUAL-BAND MOBILE

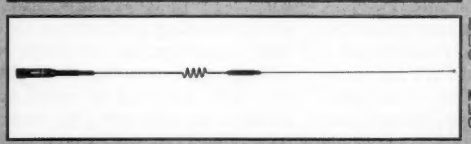
CA-2x4MB
Dual-Band 146/446MHz
Gain & Wave:
146MHz 4.5dB 7/8 wave
446MHz 7.0dB 5/8 wave x 3
Max Power: 150 watts
Length: 4' 10"
Connector: PL-259

BEST SELLER

CA-2x4SR
Dual-Band 146/446MHz
Gain & Wave:
146MHz 3.8dB 5/8 wave
446MHz 6.2dB 5/8 wave x 2
Max Power: 150 watts
Length: 3' 4"
Connector: PL-259

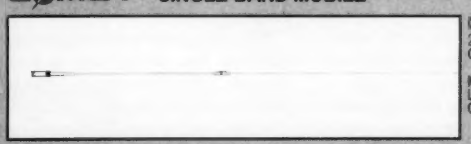


B-10/B-10NMO
Dual-Band 146/446MHz
Gain & Wave:
146MHz --dB 1/4 wave
446MHz 2.15dB 1/2 wave
Max Power: 50 watts
Length: 12"
Connector: PL-259 or NMO Style



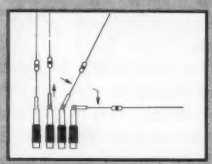
B-20/B-20NMO
Dual-Band 146/446MHz
Gain & Wave:
146MHz 2.15dB 1/2 wave
446MHz 5.0dB 5/8 wave x 2
Max Power: 50 watts
Length: 30"
Connector: PL-259 or NMO Style

COMET™ SINGLE-BAND MOBILE

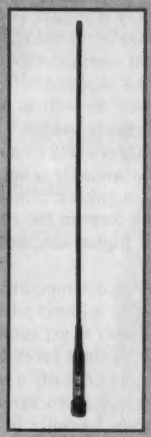


CHL-165
2 Meter Mobile Antenna
Gain & Wave:
4.1dB 5/8 wave
Max Power: 200 watts
Length: 4' 8"
Connector: PL-259

CH-32
Miracle Baby 146/446MHz HT
Gain & Wave: 0dB
Max Power: 10 watts
Length: 1.75"
Connector: BNC



Fold-Over Base
Comet mobile antennas of length have this feature



SH-55
2M/440MHz
SUPER Flexible
HT Antenna
Gain & Wave:
146MHz 1.5dBi 1/4 wave
446MHz 3.2dBi 5/8 wave
Max Power: 10 watts
Length: 15"
Connector: BNC

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Heavy duty, low-profile trunk-lip mount. Rubber coated base protects vehicle paint, ratchet style dial lock.

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304M Standard Cable Assembly
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a.) Your working surface is drawing heat away from the connector—remember, don't do this on a metal surface!

b.) Your soldering gun isn't powerful enough. Try a bigger one—although the 260 watt model should be sufficient.

c.) Your connector body is not silver-plated, but it is plated with other metals that do not "wet" as well as silver. Or, maybe the connector is oxidized, in which case it should be thoroughly cleaned prior to use.

d.) Your solder is weird, and either lacks a rosin core (which is essential to dissolve oxides that form in the soldering process), or is some higher-temperature alloy. Check it out.

e.) You're not applying enough pressure between the soldering iron's tip and the connector body to get good heat transfer.

10) Take a short break to let the connector and cable cool off a bit. To accelerate this process, I often use a brief squirt of "circuit cooler" (available in any electronic parts store). These "coolers in a can" are made of chlorofluorocarbons (if you don't care about the environment) or chlorodifluoromethane (if you do) and release an *extremely* cold spray (so cold, in fact, that it can damage your skin if exposed directly), so if you choose to use it, be careful. A brief (two-second) squirt of this stuff will bring down the connector temperature very well, and it helps accelerate the process. If you don't want to use the cooling spray, wait a minute or so for the connector to cool down before proceeding. This is mostly to prevent damage to the cable dielectric, which will also be very hot and could deform if the cable and connector are handled prior to a cooldown period.

(11) Now you're ready to solder the center pin. Use the gun again, applying the tip to the junction of the wire conductor protruding from the pin and the pin itself. Apply a small amount of solder, and when it starts to flow, move the iron's tip slightly down the *side* of the pin to draw the solder down into the connector pin. Add just a bit more solder at the tip, and cover the exposed wire conductor and the opening in the end of the connector pin so there are no holes or gaps here. This operation only takes a few seconds to complete because the center pin is a much smaller heat sink than the connector body.

Wait several seconds for the pin to cool off. Use a sharp diagonal cutter to cut off any extra wire conductor protruding beyond the end of the connector pin. Then wipe the whole pin down with solvent (alcohol, trichlor, flux remover or whatever) and a soft cloth to remove any residual soldering flux. Inspect the pin for any excess solder that might have flowed down the outside of the pin. If there is any (with practice, there *won't* be), use a nail file or fine-grit emery cloth to remove the excess solder. (*Don't* use a large file or rasp, or large-grit cloth, or you risk removing all the silver plating from the pin, which will cause it to oxidize much more rapidly, leading to potentially disastrous results in the field.)

At this point, you're finished, and, if you have used the spray cooler in step #10, the entire installation should have taken less than 90 seconds from beginning to end. If you waited for a "room temperature cooldown" it probably took more like 120 to 150 seconds. Under no circumstances should this operation consume more than 2-1/2 minutes, and with practice it will go faster and you'll still get professional results.

(12) Slide the PL-259 "shell" up the cable to the connector body, and screw it on to the connector body by twisting the shell clockwise onto the body. After a few twists, the shell should fall loose of the threaded area, enabling you to pull it all the way down the connector so the leading edge of the shell is about 0.150" back from being lined up with the end of the connector center pin (Photo 1E). That's it!

Modification for Smaller Cable

All the instructions thus far were for a standard PL259 assembly on to RG213/U or other 0.405" o.d. cables (RG8/U, etc.). A few modifications are required to the instructions if you intend to use the smaller cables which require reducers. Here are the modifications, in order (see Photos 2A, B and C).

Steps (1) through (5) remain the same. The changes for using UG175/U (for RG58-sized cables) or UG176/U (for RG8X cables) reducers begin with step (6).

(6) Slide on the appropriate reducer over the cable, with the large-diameter (big) end towards the balance of the cable and the smaller-diameter end facing towards the cable end you just stripped. The reducer should have a slightly snug fit over the cable jacket to work properly. If it slides on *too* easily (no force required at all), it will be difficult to make the connector assembly weatherproof. A too-loose fit indicates a non-standard reducer (check to be sure it's a real UG175 or UG176 type) or a non-standard (too small) cable diameter. This should *not* happen with mil-spec cables, but can occur with commercial types.

(7) Line up the small end of the reducer with the cut end of the coax jacket material so the reducer is flush with the cable jacket, where the exposed braid begins. Holding the reducer in this position with one hand, fold the braid back gently using your other hand. It will fold back easily. Gently pull it down, little by little, until it's all neatly folded back along the surface of the reducer. If you stripped the cable properly according to step (4), the braid strands should end exactly at the beginning of the threads on the reducer. If the braid strands end much *before* the threaded area of the reducer you didn't strip away enough jacket material in step (4) and you must start again. If the braid strands are so long that they overlap the threaded area of the reducer, they are too long and will interfere with the connector assembly. Trim the braid strands back neatly using the small, sharp scissors until they all end right about where the reducer threads begin. The objective here is to avoid having the braid strands pinched between the reducer and the connector body.

(8) You will now find that a lot of dielectric material is exposed between the folded-back braid and the beginning of the center conductor. This is normal. The dielectric must be further stripped off the cable, 1/16" maximum from where the reducer starts, leaving at most 1/16" of dielectric material showing when you're finished. This will leave the stripped (exposed) center conductor quite long, but there is no harm in this because the excess will be cut off.

Now, skip to the *original* step (7), as printed earlier in this article, and follow those directions, *except* that instead of screwing the connector body onto the coax jacket, you'll be screwing it onto the reducer. These threads will mate perfectly if the reducer and the connector body are properly aligned and "squared up" with each other. When the reducer is fully threaded into the connector body, it should push tight up against the connector body, leaving no space between the reducer "nut" (large-diameter part of the reducer) and the connector body itself. If there's any space at all here, the reducer is not properly seated in the connector and this will present a problem with regard to completing the assembly, making it work, and making it weatherproof.

Continue with the assembly procedures detailed in the original steps number (8) through (12). If you have followed these directions precisely up to this point, the cable braid should be exposed through all four connector body soldering holes and the soldering and final assembly operations will be the same as for installing a PL259 onto RG213/U.

Final Notes

My directions differ slightly from those shown in the *ARRL Handbook* and other texts written on this subject in that I instruct you to cut braid and dielectric off flush, so they are both the same length (for the RG213/U assembly), rather than leaving some dielectric exposed between the end of the braid and the start of the exposed center conductor. From my 27 or so years of experience installing probably ten thousand of these connectors, my way works better and will result in a more rugged, reliable assembly. There is *no* risk of producing a short circuit in the cable using my method, if it's done properly, so there's no reason at all to leave any dielectric exposed at the end of the braid.

The photographs accompanying this article show how things look as they're going together, and how they should look when you're done. A properly-installed PL259 is so strong that it cannot be pulled off the cable even with a few hundred pounds of tension. When performing the "pull test" on

my cable/connector assemblies (that is, pull on the connector until something breaks!), I can always stretch and break the cable itself before the connector comes off the cable.

When performing step (2) of these instructions, where you use the razor to cut all the way through the jacket, braid and dielectric, but stop short of cutting into the center conductor, you will probably find it takes some practice to determine where to stop cutting and avoid damaging the center conductor. That's fine! Use a scrap piece of cable and make several cuts until you know just how much pressure to apply to get this right. In time, you'll get the "feel" of this, and then in the future it will be a breeze! Razor blades and knives are very sharp and even a small nick can cut a very deep gash in your flesh. You might want to use workman's gloves to help prevent cuts, or at least keep some Peroxide solution and Band-Aids handy to patch yourself up quickly in the event of a mishap (I've only cut myself about a million times doing this.)

So much for PL259s. My next article will detail the installation of higher-frequency connectors, the popular Type "N" and "BNC," which are usable into the SHF spectrum. These are easier, not more difficult, to install than PL259s, because no soldering of the braid is required. 73

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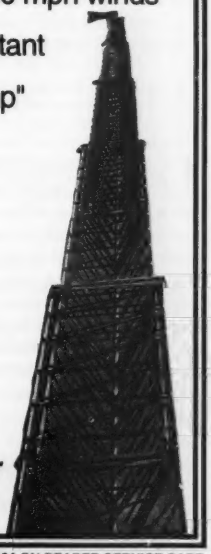

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Portable Packet Digipeater for Emergency Service

by John Neeley K6YDW

During the forest fire season, California has many major fires, some raging for several weeks. A call to amateurs for assistance in communications by various local, state and federal agencies is filled by the volunteers. During these disasters, the agencies involved need more portable packet stations and portable digipeaters. Some locations are not accessible directly from the stations at the remote fire camps due to mountainous terrain or other obstacles. The need for highly portable, battery-operated digipeaters is obvious. Packet stations are used to pass logistical messages to and from the camps, along with health and welfare messages from the firefighters.

The August and September 1987 issues of *CTM Magazine* contained a two-part article by Robert Hoover KA6HZF titled "Captain Kirk's Lunch Box," which was about a totally self-contained, battery-operated, solar-charged portable digipeater. Mr. Hoover's article dealt with a complete package housed in a single GI ammo box. It included a Yaesu FT-23 2 meter HT, an MFJ-1270 TNC and a single 14 amp-hour motorcycle battery, along with an external solar panel.

Photo A. The HT/TNC and battery box connected.

I thought this was a great idea, but I didn't have the tiny HT that Mr. Hoover had. I did have an older Kenwood TR-2500 2 meter HT as a spare, and a spare TNC, the MFJ-1270. Since the TR-2500 is much larger than the FT-23, I had to rethink how I could get this all into a compact package. The answer was to use two boxes: one for the HT/TNC and the other for a dual-battery pack which also included the solar controller circuit board (Photo A). The following article is a guide to building your own unit, no matter

Continued on page 18

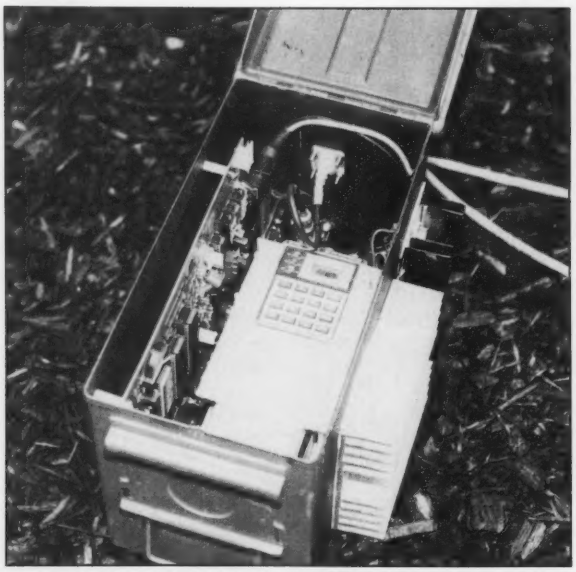

Photo B. Inside the HT/TNC box.

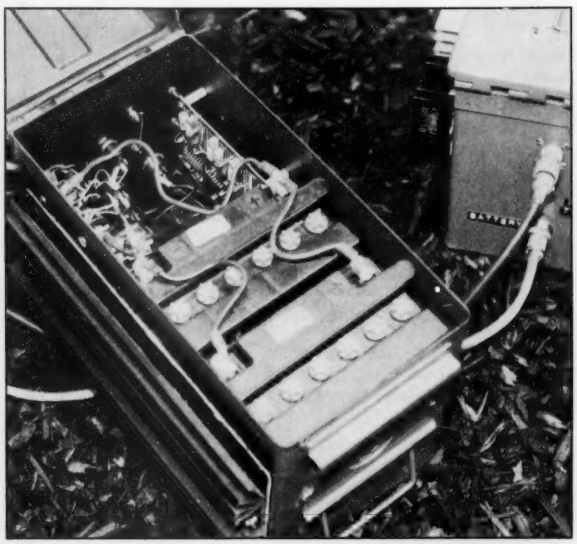

Photo C. Inside the battery box. The solar controller board is in the upper right corner.

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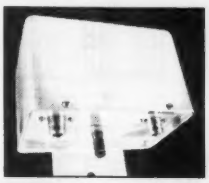

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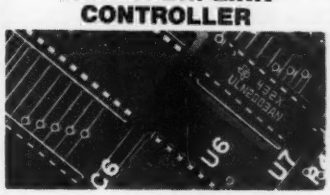

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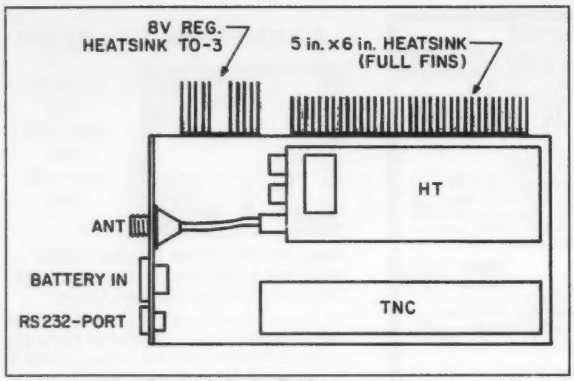

Figure 1. Radio/TNC box, top view.

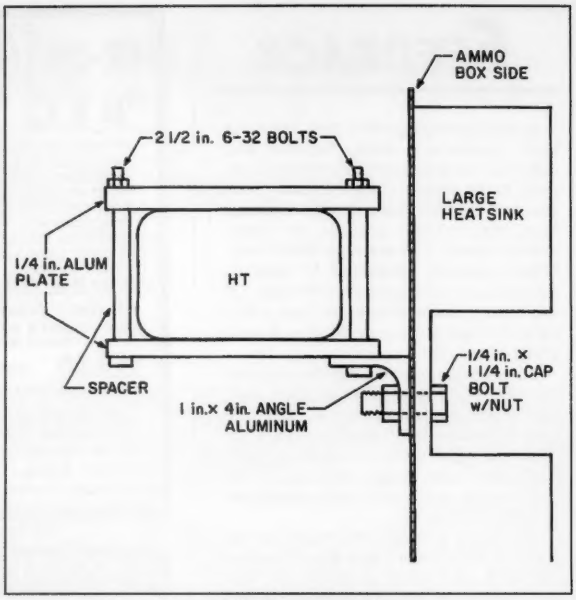

Figure 2. HT mounting scheme.

Continued from page 16
what kind of HT or TNC you use.

Radio/TNC Box

The GI ammo boxes are the standard type of box found in most army surplus stores or at flea markets. The size of the box is 5-1/2" W x 7-1/4" H x 11-3/4" (Photo B).

How you prepare the mount for the HT or TNC inside the box depends on which brand you use. Most of the older type of HTs are approximately the same physical size so most will fit in the box the way it was done here.

The MFJ-1270 TNC must first be removed from its enclosure so it will fit inside the box. There are four mounting holes in the circuit board. Take a stiff piece of paper, the same size as the board, and mark all four holes. This will be the drilling template for the TNC board mounting holes. Notice that there is a 5 volt regulator on the end of the board. This must be mounted flush to the inside of the box. First, remove all five LED lamps as they are not required for digipeater service. I did leave the "Power ON" LED, but bent it up into a position that would clear the inside of the box. This gives me an indication that there is power going to the box. Before mounting the TNC board to the box, using 1/2" metal spacers, first scrape away any paint from the area where the 5 volt regulator is going to touch and apply a liberal amount of heat-sink compound. Also, the top two mounting holes will require the use of flathead type bolts instead of roundhead types. This allows the top lid of the box, which has some long sides, to clear the boltheads.

The mounting of the HT unit will depend on just what you are going to use, but most can be mounted in this fashion. See Figures 1 and 2. I used some scrap 1/4" aluminum plate for both the top and bottom shelves. The bottom shelf is bolted to a piece of 1" aluminum angle stock, approximately four inches long, and this angle stock is then bolted to the side of the box. On the outside of the box, where the bottom shelf attaches, is a large heat sink to dissipate any excessive heat generated either by the units inside or by any direct sunlight on the box. There are different ways in which the heat sink can be mounted to the surface of the box, depending on what style of heat sink is used, so I will not go into the details.

In cutting the bottom shelf for the HT, place the HT down on the plate and trace out the outer dimensions. Now, mark the plate 3/8" larger on all sides, as this will give

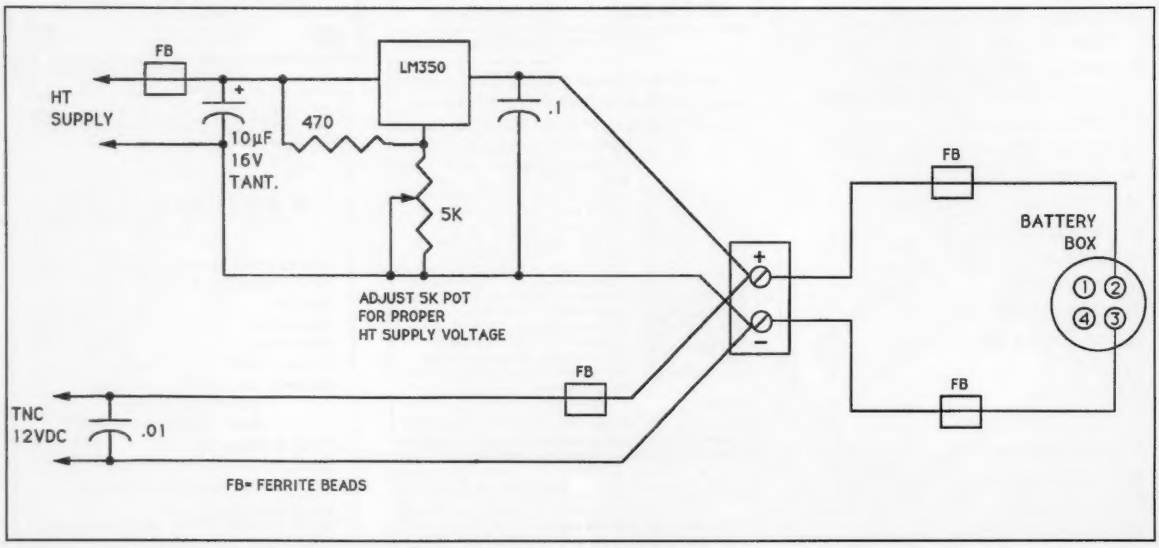

Figure 3. 1.2-32 volt variable power supply.

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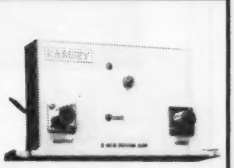

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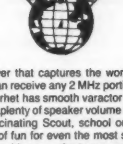

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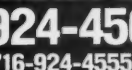

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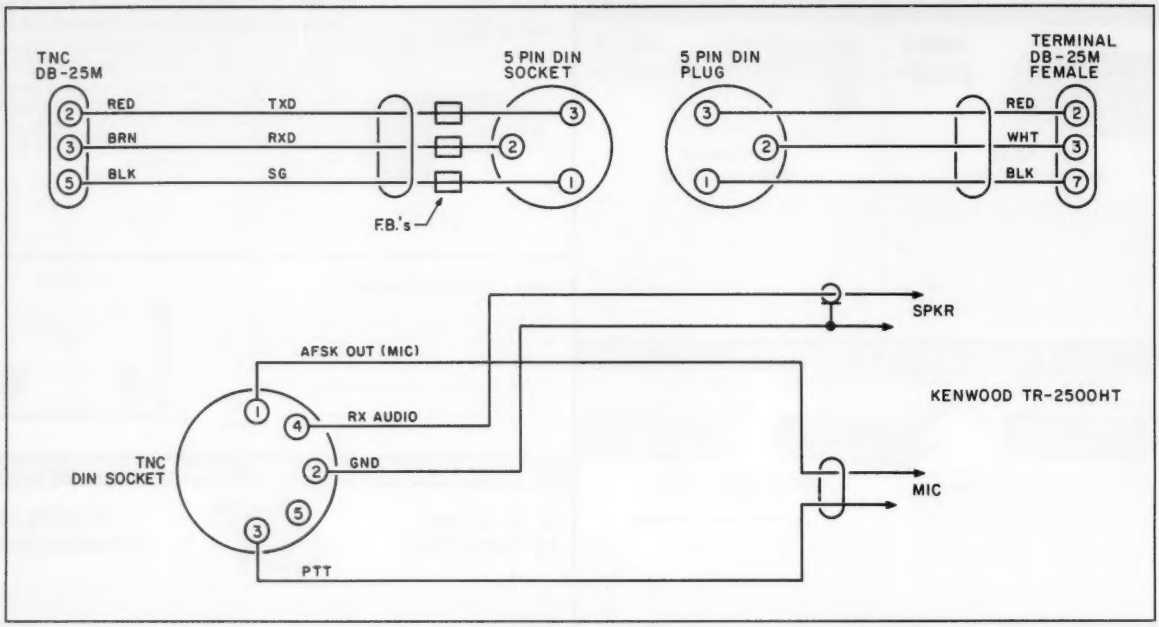

Figure 4. Detail "A."

room to place the mounting bolts. Make the top shelf the same size as the bottom, cutting out for any controls, displays, etc. I used 2-1/2" x 6/32" bolts, using metal spacers to get the correct height needed between the two shelves. Once they are tightened down the HT is very secure.

Three holes are required in the end of the box for the antenna output, the battery input and the RS-232 I/O port.

Since the Kenwood TR-2500 HT uses an 8.4 volt battery pack for power, I installed an LM-340-8K voltage regulator on the outside of the box, next to the large heat sink. Be sure to heat-sink this TO-3 package.

The power voltage required will depend on what HT you plan on using. Some use 12 volts, some less. For voltages other than 12 volts, a simple regulated supply is on the same board as the solar controller and uses a LM350 regulator. The 5k variable resistor will change the HT supply voltage and can be adjusted for the TH you use (see Figure 3).

Different brands of TNCs are of various physical sizes. Some may mount in the box without having to remove the enclosure. Be sure that the TNC has a "watchdog" circuit to prevent a locked keydown condition. Some TNCs do not have this feature.

Since I planned on using the unit as a portable packet station, I put a 5-pin DIN jack on the outside of the box for my RS-232 I/O port. Placing a DB-25m plug on a 3-conductor ribbon cable, which connects to the DB-25f connector on the TNC, the other end is connected to the 5-pin DIN (see Figure 4). Place a single ferrite bead on each line to the DIN jack. Also, place as many ferrite beads as possible on all lines within the box. This is just a precaution against any stray RF that may be floating around inside the box. [Note: I have had no problems with stray RF within the box and next to the bare board TNC, even with the plastic case of the TR-2500.]

Battery/Solar Charge Controller Box

I was unable to install a single motorcycle battery inside the same box as the HT and TNC so I had to get a second box. There was plenty of room inside this second box so I decided to use two batteries, which would give me a total of 24 Ah (see Figure 5 and Photo C). Mounting the batteries is fairly simple as they will fit in sideways, leaving approximately four inches on one end for the solar charge controller board and associated output jacks. Be sure to measure the size of the batteries to make sure they will

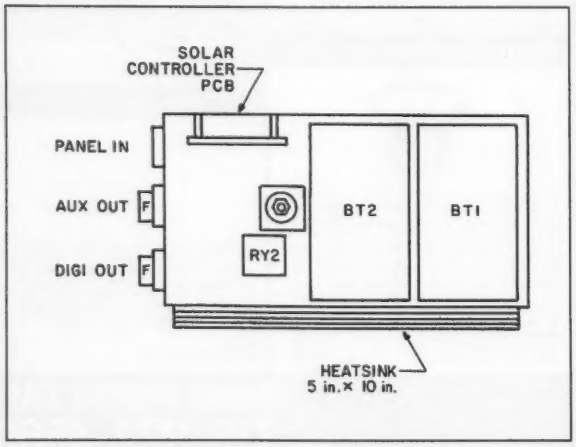

Figure 5. Battery solar controller box, top view.

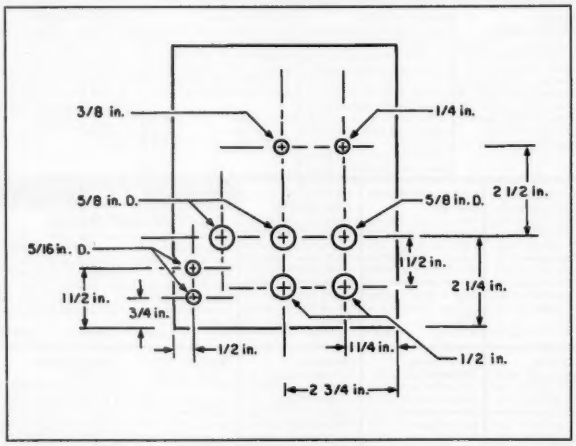

Figure 6. Battery box.

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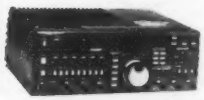

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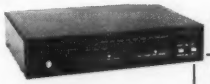

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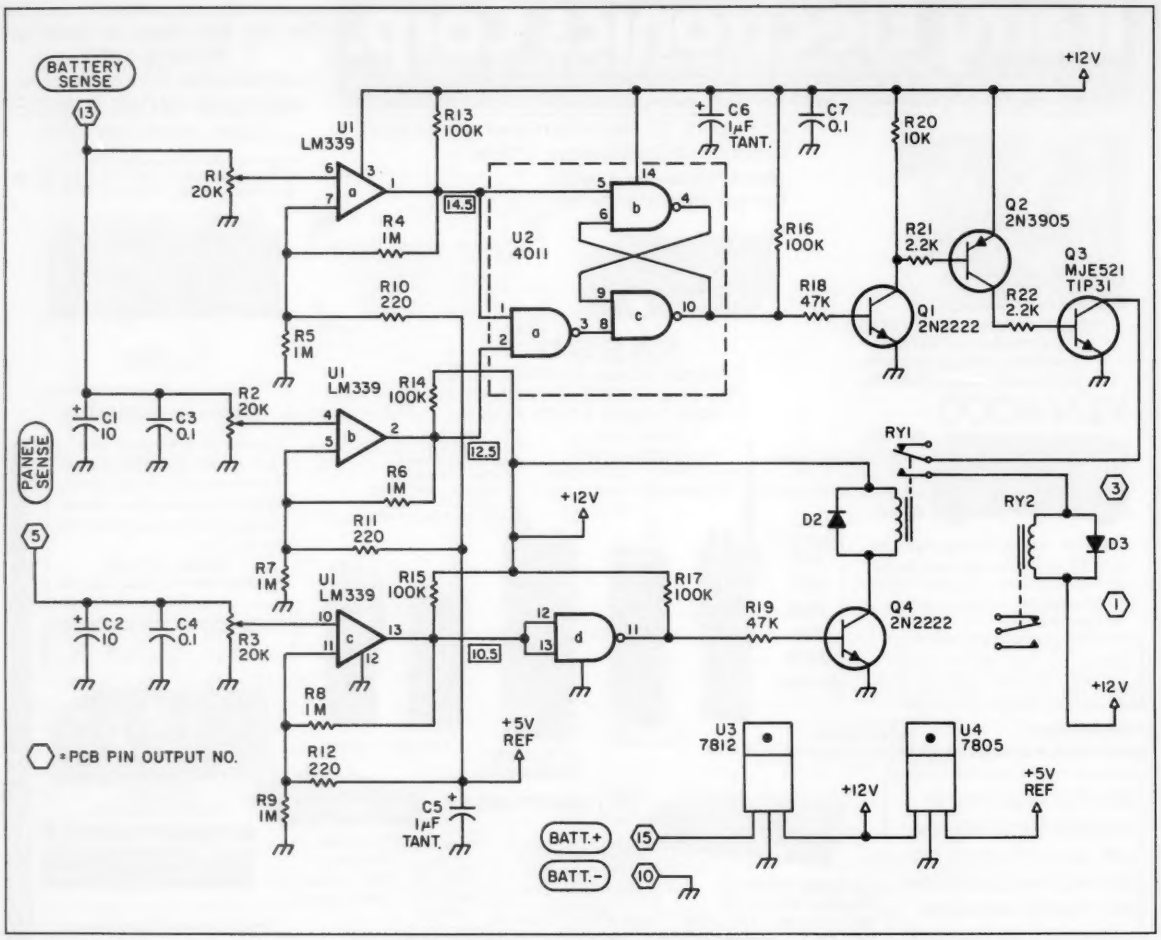

Figure 7. Schematic for the solar controller.

fit inside the box. It is a snug fit, but not binding. Make a metal bracket to hold the batteries in place so they won't shift around. I used a piece of angle steel stock for my bracket.

The output jacks on the outside of the box are for DIGI, AUX OUT and PANEL IN. The DIGI jack is the power for the RADIO/TNC box and has a one amp fuse inline with its output. The AUX OUT jack is a parallel jack with the DIGI jack, with a 3 amp fuse inline. This AUX OUT jack can be used to power any external unit, like a transceiver, another digipeater, etc. The PANEL IN jack is the solar panel input to the charge controller. You will see in the template drawing of the box (Figure 6) that I have placed two 5/16" holes near the bottom of the box. These are for the breather tubes coming from the batteries. Also, the "Charge" LED and power switch for the controller are mounted on the end of the box.

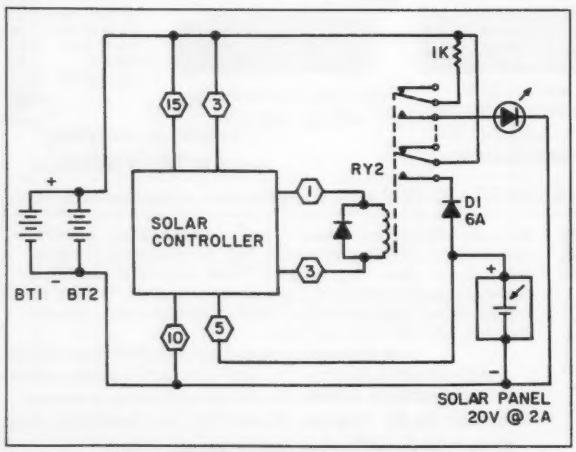

Figure 8. Solar controller external wiring.

Solar Charge Controller

The basic circuit for the controller uses three sections of an LM-339 voltage comparator IC (see Figure 7). Two sections are used to monitor the HIGH and LOW battery voltage, and the third section is used to monitor the voltage output from the solar panel. I found several articles dealing with solar charging in various publications, and by combining features of these articles I came up with my own simplified version. The project can be built on a printed circuit board available from FAR Circuits, 18N640 Field Court, Dundee IL 60118 for $8 plus $1.50 S & H.

Alignment of the circuit will require a variable power supply (+10-15V), a digital VOM and a logic probe. First, connect both the battery sense and panel sense input lines to the same point. Adjust the voltage output of the supply to 14.5 volts and place the logic probe on pin 1 of the 339. Adjust the 20k pot, R1, to where the probe goes LOW. Set the power supply to 10.5 volts and adjust R3 to where pin 13 goes LOW. Rock the supply to make sure all the set voltage points are set

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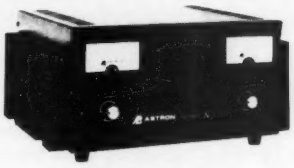

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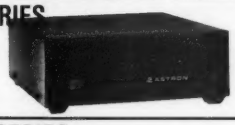

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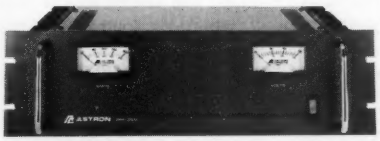

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RM-50M	37	50	5¼ × 19 × 12½	50
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MODEL RS-7A

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RS-4A	•	•	3	4	3¾ × 6½ × 9	5
RS-5A		•	4	5	3½ × 6⅛ × 7¼	7
RS-7A	•	•	5	7	3¾ × 6½ × 9	9
RS-7B	•	•	5	7	4 × 7½ × 10¾	10
RS-10A	•	•	7.5	10	4 × 7½ × 10¾	11
RS-12A	•	•	9	12	4½ × 8 × 9	13
RS-12B		•	9	12	4 × 7½ × 10¾	13
RS-20A	•	•	16	20	5 × 9 × 10½	18
RS-35A	•	•	25	35	5 × 11 × 11	27
RS-50A	•		37	50	6 × 13¾ × 11	46

RS-M SERIES

MODEL RS-35M

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
• Switchable volt and Amp meter				
RS-12M	9	12	4½ × 8 × 9	13
• Separate volt and Amp meters				
RS-20M	16	20	5 × 9 × 10½	18
RS-35M	25	35	5 × 11 × 11	27
RS-50M	37	50	6 × 13¾ × 11	46

VS-M AND VRM-M SERIES

MODEL VS-35M

• Separate Volt and Amp Meters • Output Voltage adjustable from 2-15 volts • Current limit adjustable from 1.5 amps to Full Load

MODEL	Continuous Duty (Amps) @13.8VDC	@10VDC	@5VDC	ICS* (Amps) @13.8V	Size (IN) H × W × D	Shipping Wt. (lbs.)
VS-12M	9	5	2	12	4½ × 8 × 9	13
VS-20M	16	9	4	20	5 × 9 × 10½	20
VS-35M	25	15	7	35	5 × 11 × 11	29
VS-50M	37	22	10	50	6 × 13¾ × 11	46
• Variable rack mount power supplies						
VRM-35M	25	15	7	35	5¼ × 19 × 12½	38
VRM-50M	37	22	10	50	5¼ × 19 × 12½	50

RS-S SERIES

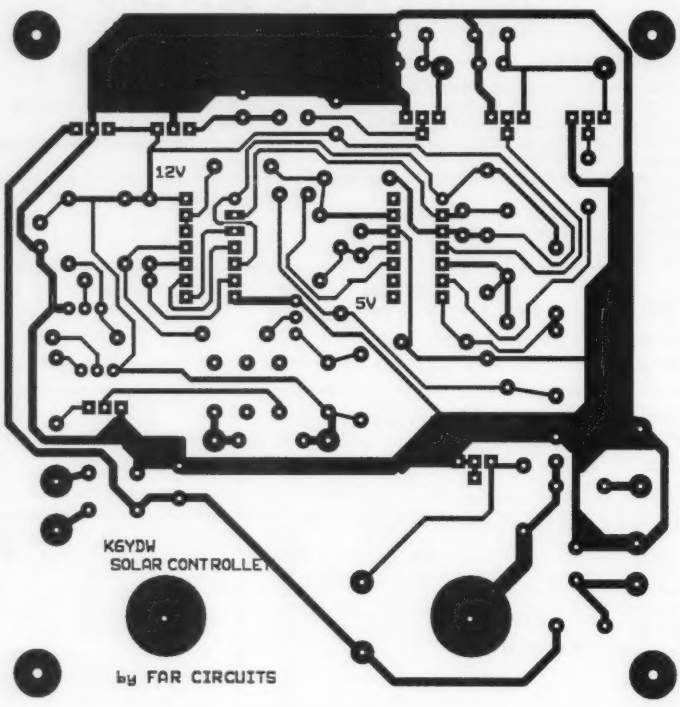
MODEL RS-12S

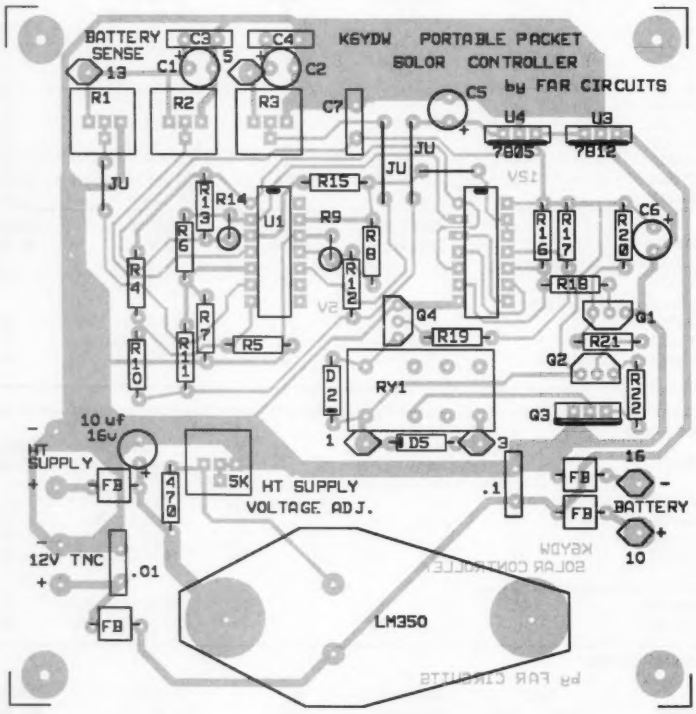
• Built in speaker

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* Amps	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-7S	•	•	5	7	4 × 7½ × 10¾	10
RS-10S	•	•	7.5	10	4 × 7½ × 10¾	12
RS-12S	•	•	9	12	4½ × 8 × 9	13
RS-20S	•	•	16	20	5 × 9 × 10½	18

*ICS—Intermittent Communication Service (50% Duty Cycle 5min. on 5 min. off)

CIRCLE 16 ON READER SERVICE CARD





correctly. The controller is now ready to be mounted in the box.

Attach the battery sense line to the positive battery post on the battery. Do not attach it to any other point. Then, attach the panel sense line to the output of the solar panel, making sure you have connected it on the anode side of the blocking diode, D1. The blocking diode is used so the panel sense circuit will not be fooled by the voltage output of the batteries. The 10.5 voltage sensor portion of the circuit is not required; it's just as an added feature. The charge circuit will work without it, but I use it as a "day-night" switch. See Figure 8.

Operation of the controller is fairly simple. As long as the panel sense voltage is above 10.5 volts the circuit is active. If the panel sense voltage falls below 10.5 volts, then RY1 is disabled, thereby preventing any charge voltage to the batteries. When the voltage from the solar panel rises to above 10.5 volts, RY1 is connected between the collector of Q3 and the coil of RY2, which allows any charge voltage from the solar panel to flow when requested by the controller circuit.

When the battery post voltage falls to 12.5 volts, pin 2 of the LM339 comparator goes LOW, thereby turning on RY2, allowing current to flow from the panel to the batteries for charging. When the battery post voltage reaches 14.5 volts, pin 1 of the 339 will go LOW, turning off RY2. The "float charge level" is 14.5 volts for most lead-acid batteries.

General Information

The total weight of both boxes is 33 pounds, fully loaded. This weight is a bit excessive, but you have a rugged and, for the most part, weatherproof unit that can be placed in any location desired, like under a large boulder, bush or tree, and it will provide signals to reach from your remote location to the next digipeater.

For an antenna I use a modified Hustler CG-144 5.8 dB mobile whip to which I have attached three radials. This antenna is then mounted on a 5-foot section of TV mast. Three other 5-foot sections are added to give a total height of 20 feet, which can be placed in the rocks or self-supported with some nylon rope. For coax, a good choice is RG-8/x mini-foam, as it is quite flexible and has good characteristics at this frequency. For the two-conductor cable between the two boxes, use a good quality cable which has a heavy outer sheath. I also use this type of cable between the box and the solar panel. For all power connections I use 4-pin microphone connectors. This type of connector provides screw mounting, which gives security in remote locations where other types of connectors could be pulled out by animals walking by. For this reason, do not use phono type connectors.

For extra weatherproofing protection, you can cover the boxes with a small tarp. This

Figure 9. PC board and parts placement.

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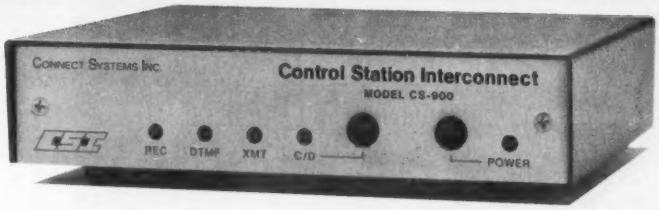

The CS-900 is voice activated and can be used simplex or through any remotely located repeater. The standard ½ Second Electronic Voice Delay totally eliminates syllable or word clipping and results in unsurpassed simplex performance. The only required connections are to the Mic and Speaker jacks of your simplex transceiver.

CS-700 INTELLIGENT INTERCONNECT

The CS-700 is for simplex operation and offers selectable VOX Enhanced or VOX Controlled Sampling. Sampling allows the mobile operator to have positive control at all times. The CS-700 requires an internal connection to the discriminator of your simplex transceiver.

CS-800 FULL DUPLEX INTERCONNECT

The CS-800 will operate Full or Half duplex and also has a built-in Repeater Maker. The two transformer hybrid provides superb trans-hybrid isolation. The only required connections are to the Mic and Speaker jacks of your dual band transceiver.

CS-900 STANDARD FEATURES: • ½ Second Electronic Voice Delay • 90 memory speed dialer • Redial • Single or multi digit access codes • Toll Restrict • Built-in programming keyboard and display • Regenerated tone or pulse dialout • Remote base mode • Land to mobile selective calling • Ringout on 1-9 ring • Line in use detect • Call waiting • Hookflash • CW ID • And more!

CS-700 and CS-800 STANDARD FEATURES: • 9 memory speed dialer • Redial • Single or multi digit access codes • Toll Restrict • Built-in programming keyboard and display • Regenerated tone or pulse dialout • Ringout on 1-9 ring • Line in use detect • Call waiting • Hookflash • CW ID • Auto-Setup and more!

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CIRCLE 12 ON READER SERVICE CARD

will also shield the boxes from any direct sunlight. Also, turn both boxes to where the heat sinks are facing north, or are in the shade all the time.

The boxes should be painted with a good quality rust inhibitor paint. The bottom and the side on which the large heat sinks are mounted should be a flat black finish. Other areas should have a light-color finish to help reflect heat.

The dual-battery setup will provide plenty of backup power in case of poor voltage output from the solar panel due to clouds, smoke or haze. I have run a test using just the fully charged batteries alone, with no charger in the circuit. When I set the TNC to beacon one line of text every 10 seconds, and the HT to full power of 2.5 watts out, it ran for five days with only a half volt (0.5V) drop through the test period. There is no reason you cannot use just a single battery instead of two. The total package would be lighter by about 15 pounds.

Operation

The system should be set up before you transport it to a remote location. Plug your terminal into the RS-232 I/O port on the HT/TNC box, then apply power to the system by plugging in the power cable from the battery box.

The following parameters are for the TNC-2 type, for unattended digipeater service:

CONOK-OFF:	DWAIT=0:
TXDELAY=50:	DIGI=ON:
USERS=0:	MON=OFF:
HID=ON	

Unplug the power cord and disconnect the terminal. You are now ready to use this system when needed.

Whatever HT/TNC and battery combination you use, it will have to be a special design to fit your needs.

Parts List for Solar Controller

Integrated Circuit		
U1	LM339 voltage comparator	RS276-1712
U2	4011 CMOS quad two-input NAND gate	RS276-2411
U3	12 volt voltage regulator	RS276-1771
U4	5 volt voltage regulator	RS276-1770
Transistors		
Q1,Q4	General purpose NPN (2N2222, 2N3904, etc.)	
Q2	General purpose PNP (2N3905, etc.)	
Q3	TIP31 NPN	RS276-2017
Diodes		
D1	Silicone 50V at 6 amps (1N5400, etc.)	
D2,D3	1N4001	
Resistors		
R1,R2,R3	20 kilohm 15-turn trimmers	RS271-340
R4,R5,R6,R7,R8,R9	1 megohm 1/4 watt	
R10,R11,R12	220 ohm, 1/4 watt	
R13,R14,R15,R16,R17	100 kilohm, 1/4 watt	
R18,R19,R22	47 kilohm, 1/4 watt	
R20	10 kilohm, 1/4 watt	
R21	2.2 kilohm, 1/4 watt	
Capacitors		
C1,C2	10 µF, 35V electrolytic	
C3,C4,C7	0.1 µF, 50V disc	
C5,C6	1 µF, 35V electrolytic	
Relays		
RY1	12V DPDT (16-pin DIP)	RS275-249
RY2	12V DPDT (10 amp contacts)	
Batteries		
BT1,BT2	12V at 14 Ah motorcycle-type or gel-cel	

Circuit boards are available from FAR Circuits, 18N640 Field Court, Dundee IL 60118 for $8 plus $1.50 S & H.

This article is intended as a simple guide. Any comments are welcomed, and a SASE will be appreciated for any return comments. 73

Acknowledgements:

"Captain Kirk's Lunch Box, Part 1," by Robert Hoover KA6HZF, *CTM Magazine*, August 1987, page 21.

"Captain Kirk's Lunch Box, Part 2," by Robert Hoover KA6HZF, *CTM Magazine*, September 1987, page 28.

"Total Solar" by Michael Bryce WB8VGE, *73 Magazine*, May 1986, page 60.

"The Battery Topper," by Michael Bryce WB8VGE, *CTM Magazine*, June/July 1987, page 25.

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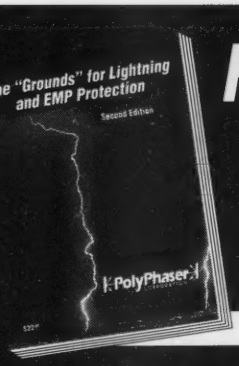

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16 Tips For Using PCB Layout Software

You can do things differently when you design a PCB on your computer.

by Jim Tarchinski N8PTG

Fewer and fewer printed circuit boards (PCBs) are laid out by hand these days. The reason is simple: More and more hams are using computers to create the artwork for their boards.

There are many reasons for this trend away from hand-taped artwork, but there are two main ones. First, prices for PCB layout packages are only a fraction of what they were just a few years ago. In fact, there are even a few shareware programs floating around that allow you to lay out a board on your computer (see the sidebar). Prices are definitely in a range that is affordable to most casual PCB creators.

The second reason layout programs are becoming so popular is that they can shorten the time it takes to design a board from scratch. This is especially true if the software can automatically route the traces, or check your traces against a network connection list (netlist) generated by a schematic drawing program.

Like any other change, however, going from hand-taped to computer-created artwork requires you to change your thinking somewhat. There are some things that can be done, or even should be done, differently. I've learned a few tricks in the year or so that I've been using a layout program, so I'd like to share some of them with you. This article offers 16 tips to help you make a smooth transition to creating computer-based PCB layouts.

Tip #1

Before you even begin to lay out a board, give some thought to how it will eventually be mounted. If you bought an enclosure at the last swap meet that will work perfectly, you'll need to consider this up-front. This could influence your selection of components or your decision on the layout.

Tip #2

Except for the tip I just mentioned, don't decide on a board size until you make an initial layout and get a rough idea of how much board area is required. Once you have a good handle on this, be sure to select either a standard PCB size or the size of a remnant you have on hand. After all, why cut a larger board down to size if you don't have to?

Tip #3

Don't choose a double-sided board unless you're forced into it. Start by running traces on the solder side only. If you run into too many intersecting traces you can always switch to a two-sided board. It's often surprising how many traces will fit on only one side, especially if your layout program has an excellent "auto-route" algorithm. It's also worth remembering that jumper wires can frequently get you out of a bind on a single-sided board (and even on some double-sided ones!).

Tip #4

When possible, place mounting holes at half-inch increments from one another. Then, when you go to drill the mounting holes in the project case, you'll find that it's much easier to mark off half-inch distances than an odd number of 0.1-inch increments, the step size that most programs use.

Tip #5

For dual-sided boards, be sure to write "Solder Side" and "Component Side" right on the layout. This will help you later on when you have to determine the orientation of the clear artwork against the board. See Figure 1.

Tip #6

It's also a good idea to write the date and a version number right on the artwork—preferably on both sides of the board. This helps you keep track of multiple versions of the same project. I got hit by this once, and it took me nearly an hour to figure out that I had accidentally used an old version of my artwork on the bottom side of the board! See Figure 2.

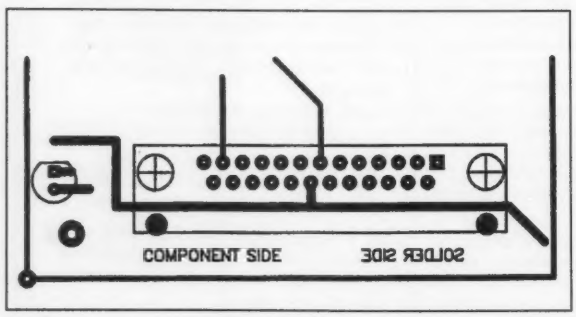

Figure 1. Tip #5.

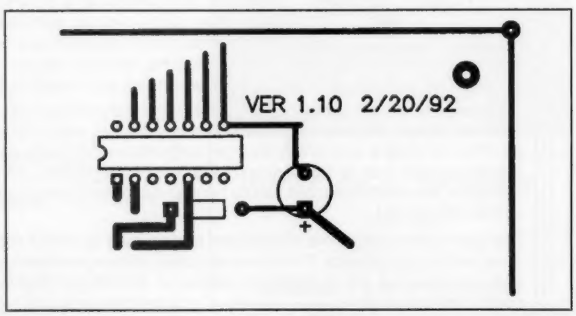

Figure 2. Tip #6.

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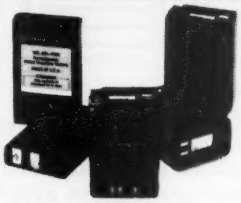

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FNB-2	10.8v @	600 MAH
FNB-3/3A	9.6v @	1200 MAH
FNB-4	12v @	750 MAH
FNB-4A	12v @	1000 MAH
*FNB-10(S)	7.2v @	1000 MAH
FNB-12	12v @	500 MAH
FNB-12(S)	12v @	600 MAH
FNB-17	7.2v @	600 MAH

equiv. to FNB-11 (½" shorter)
*Same size case as FNB-12

*FNB-25	7.2v @	600 MAH
FNB-26	7.2v @	1000 MAH
*FNB-26A	9.6v @	800 MAH

*Same size as FNB-26 case

FNB27	12v @	600 MAH
**FNB-27S	12v @	800 MAH

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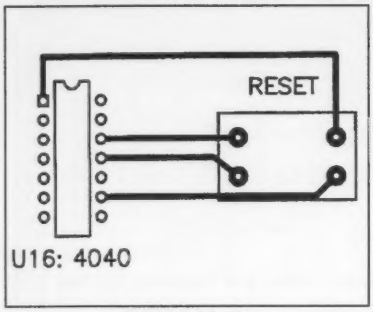

Figure 3. Tip #7.

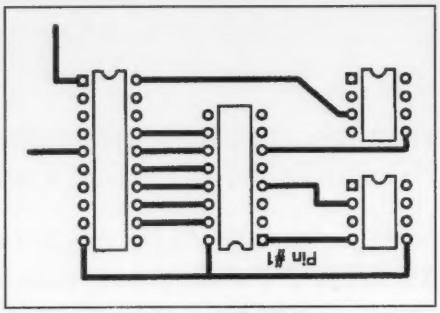

Figure 4. Tip #8.

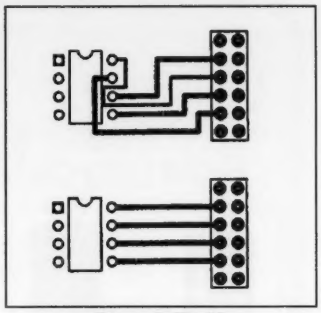

Figure 5. Tip #9.

Tip #7

Most hams don't place a silk-screen layer on their boards. In its place, consider putting important information right on either the top or bottom copper layers. If you have the room, component names and/or values are often convenient to have right on the board. See Figure 3.

Tip #8

Try to mount all IC packages in the same direction, unless this violates one of the other rules mentioned above. If you are forced to mount one IC "upside-down," be sure to clearly mark pin #1 on both sides of the board (Tip #7). See Figure 4.

Tip #9

Change the schematic whenever it helps! It's amazing how many people seem to think a schematic is set in stone when they get to the layout phase of a project. If you can redefine connector pin numbers, or use one IC gate in place of another, it frequently simplifies the board layout. Just be sure you go back and update to print so you'll remember that you made the change later on.

Although I don't recommend it, some people tend to take this tip to an extreme—they actually lay out the board *before* they draw the schematic. See Figure 5.

Tip #10

Now here's one that is really simple, but again, it's surprising how many people never seem to think of it. Remember that all pads do not have to be the same size, not even all the pads for a single component. If you need extra room (to lay a high current trace, for example) make some of the pads smaller. This is especially true for unused pads, which you may even be able to eliminate completely. See Figure 6.

Tip #11

Several times during the design, print out an exact-size copy of the layout, being sure to include the silk-screen layers even if you won't be using them. Place the actual components on this printout to make certain there's adequate space for everything. Pay particular attention to large capacitors, mounting holes for connectors, and any components whose templates you created yourself.

Also, be sure connector pin numbers line up correctly.

If you designed for a male DB25 connector, but the layout software put down a female DB25, your pin definitions are not going to be what you expect.

Tip #12

Place extra pads on unused connector pins or IC gates. You may not have a need for them later, but if your initial design doesn't work, they will make it much easier to modify the board further down the line. You may even want to include pads or component space for any "upgrades" that you might want to wire in later. See Figure 7.

Tip #13

If you don't use through-plated holes (as is the case with most hams), make certain that all the traces you run on the top layer can be soldered to the components on the top layer. For example, straight PCB-mounted connectors are frequently encased in plastic in such a way that you can only solder them to the bottom side of the board—the top side of the pins are completely blocked off.

If this causes you a problem, there are two things you might try: Either mount them to a component a few millimeters above the board so you can get an iron in there, or use a via (through-hole) near the

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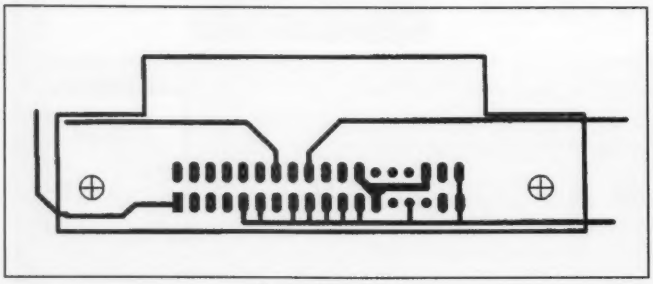

Figure 6. Tip #10.

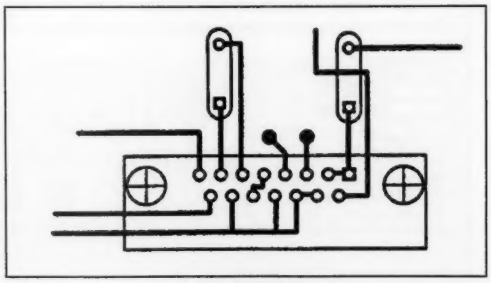

Figure 7. Tip #12.

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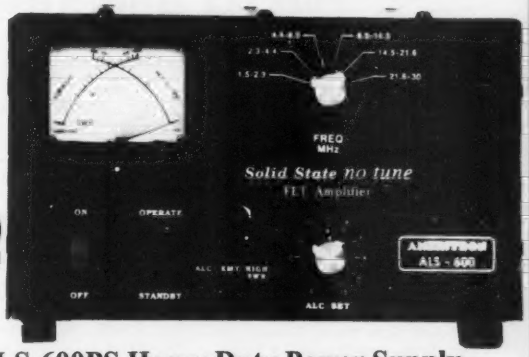

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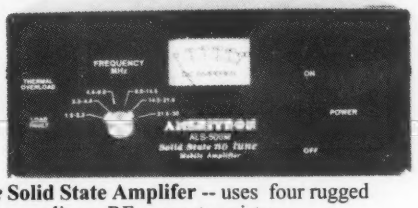

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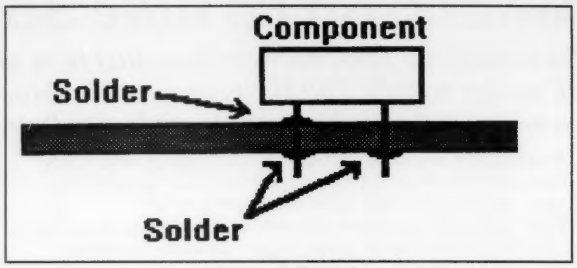

Figure 8. Tip #13.

problem pad. See Figure 8.

Tip #14

Once again, for those who don't use through-plated holes, keep vias to a minimum. You'll have to solder through every via that you design in, which is a pain in the neck. This is another handicap you may find with most auto routing routines, which tend to use vias like they're going out of style.

Tip #15

Consider creating your own personalized checklist of things you want to examine before you're finished with a layout. Before I came up with my list I frequently forgot to size my mounting holes correctly, or to run an automatic check to verify all my trace routings.

Tip #16

Don't throw away all the "good old" design rules that you used when you laid out PCBs by hand. For example, you still should keep the analog and digital sections separated, be sure to use grounding planes were necessary, and don't make the traces too small for the expected maximum current load. Most software just isn't smart enough yet to check for stuff like this (but the way things are moving, it's only a matter of time!).

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Building and Using N7APE's NiCd Zapper

An update.

by Marion D. Kitchens K4GOK

In the September 1992 issue of *73 Amateur Radio Today*, Ed Miller N7APE described a circuit for recovering NiCd batteries that have grown internal shorts. His article got my immediate attention because it seemed like a simple solution to a problem that plagues many of us. Most of us have numbers of just such NiCds. If you do much with NiCd batteries around the ham shack, then you will definitely want to build N7APE's circuit. Some hams have been known to burn out internal NiCd shorts by momentarily connecting them to an automobile battery. This can be dangerous, and is not recommended. N7APE's circuit can eliminate that danger and still recover the shorted NiCds. Furthermore, after clearing the short, the circuit will automatically switch into the charge mode and recharge the battery. A pretty neat circuit!

This article describes the experiences of two builders of N7APE's circuit, and relays the experience and knowledge they gained about recovering NiCds.

Building The Circuit

Gene WØDLQ and I both built "Zappers" according to N7APE's article. The original publication contained one error in the schematic: The correct value of R5 should be 560k, as per the parts list, and not the 560 ohm value shown on the schematic. More on optimizing the value of this resistor later. The unit shown in the photographs used an under-the-bench power supply (12 volt auto battery on a charger), while WØDLQ used a built-in AC power supply delivering about 17 VDC to the circuit. The unmarked diodes in the original publication are 1N914 or similar.

Being experimenters, both of us made minor changes in N7APE's circuit. First, as an operating convenience, a "reset" switch was added to discharge an internal cap (C7) so the unit could be easily reinitialized after recovering a NiCd. Second, some voltage dividers and sensing circuits were modified to allow use of different supply voltages. Third, a fixed voltage regulator chip was used in place of the LM317 regulator. My unit used an active LM317 current-limiting regulator in place of resistor current limiters. If the LM317 current limiter is used, it requires a 1" x 2" heat sink. If you use the fixed resistor(s) at R1, they should be rated for 2 watts.

Gene and I could not resist adding a "zapping" LED to indicate that this function was happening. You have clear indications of the zap/charge mode via the red/green LEDs. We also added a switch to allow selection of 50 mA for charging AA size NiCds, or 100 mA for charging C or D size NiCds. The changes made in our circuits are shown in Figures 1 and 2.

Checkout and Adjustments

Several adjustments need to be made after assembly. The sequence of checks and adjustments shown in the sidebar is recommended. This list provides a sequence that allows for easy resolution of problems, should they occur. Note that it is easy to get the circuit "locked up" in the charge mode, so follow the checkout instructions carefully! You can "unlock" the circuit by pushing the "reset" switch.

Adjusting R13 for about 0.500 volts on pin 6 seemed to help in recovering some of the very old NiCds. N7APE recommended about 0.300 volts, which should be fine for most users.

After getting the unit operating, optimization of the circuit is recommended. Optimization will result in the circuit delivering the maximum available energy to burn out the internal short, thus reducing the time necessary to recover a NiCd. The best method of optimization will depend on the resistor values and supply voltage in your particular unit. Try the easy way first.

The Easy Way

Short pin 5 of the IC to ground, and short across the battery box for the following operations. Adjust R10 for maximum voltage on pin 2 of the IC. Measure and record that voltage. This may cause the voltage on C1/C2 to increase and stabilize at the supply voltage. Check with a voltmeter. If the voltage is steady, you can optimize the unit the easy way. (If the voltage ramps up and down, you'll have to do it a slightly harder

Photo A. K4GOK's NiCd Zapper.

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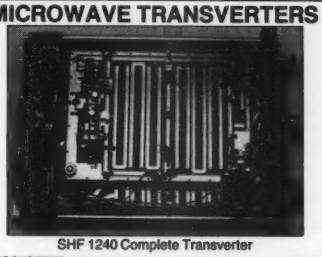

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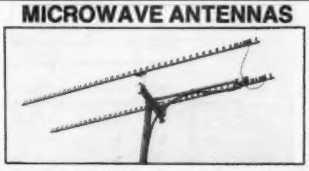

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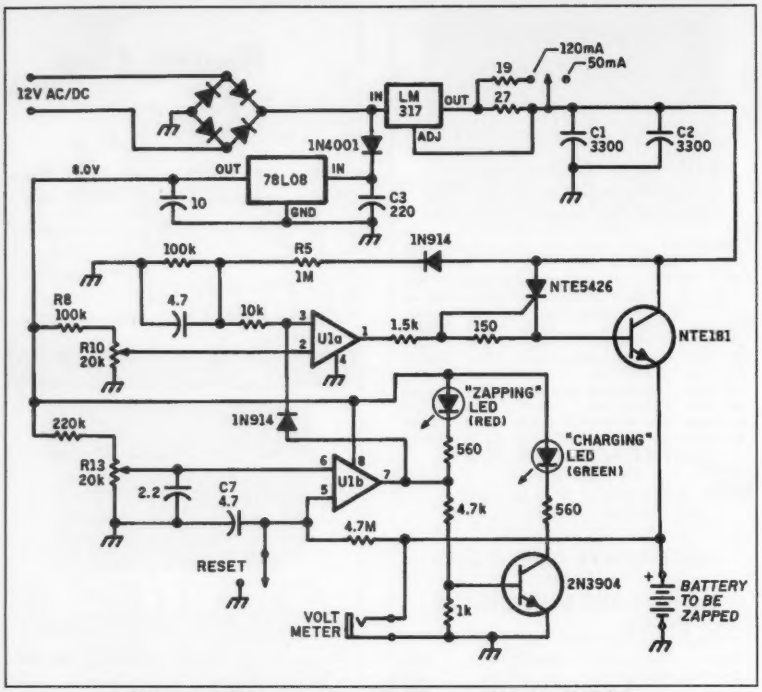

Figure 1. NiCd restorer from N7APE, as modified by K4GOK.

way, described below.) Once the voltage on C1/C2 is stable, measure and record the voltage on pin 3 of the IC; it should be less than that on pin 2. The voltage on pin 1 should be less than 1 volt. Next, adjust R10 until pin 3's voltage is just slightly less than that on pin 2. At this point, the voltage on pin 1 should be pulsing with very short pulses, and the voltage on C1/C2 should be ramping up and down.

The Harder Way

If adjusting R10 for maximum voltage on pin 2 does not stop the voltage ramping up and down on C1/C2, you'll want to make some changes in resistor values. The idea is to change either R5 or R8/R10 until you can get the ramping up and down to stop. In my unit I increased the value of R5 to 1.2 megohms, while Gene made R10 a 100k pot and replaced R8 with a jumper soldered permanently in place. The changes required will depend primarily on the supply voltage you use. In general, the higher your supply voltage, the larger the value needed at R5 or the smaller the resistor needed at R8. Make changes until you can get the voltage on C1/C2 to come up to the supply voltage and stabilize (no pulsing or ramping up and down) by setting R10 to maximum voltage at pin 2. Then adjust R10 as described above so the voltage on pin 3 is just slightly less than that on pin 2.

Check that the voltage on C1/C2 now ramps up and down. The unit will deliver the maximum energy to zap the NiCd when adjusted as described above. Remove the jumpers from pin 5 to ground and from across the battery box. Now you are ready to put the zapper to use.

Zapping Some NiCds

Using the zapper is very easy. Put in the bad NiCd and turn on the power. The "charging" LED will flash very briefly and the "zapping" LED will come on. If the power is already on when the NiCd is inserted, or if a recovered NiCd has just been removed, you will have to push the reset switch to reinitialize the circuit. The "zapping" LED stays on until the short is burned out. Then the zapper automatically switches to the charge mode and the "charging" LED comes on. Leave the NiCd in the zapper for the recommended charge time, or remove it and place it in a standard charger.

We had 16 very old NiCds on hand for learning to use the zapper. Eight of these were more than 20 years old, a good set to see just what the zapper would really do. All of these NiCds measured 0.000 volts, and obviously had internal shorts. We tried all eight NiCds for an hour or so without any signs of recovery. Additionally, we zapped all of them with the automobile battery technique, without success. The automobile battery technique had never failed before—it puts quite a large jolt of current through the cells. These NiCds were more than dead!

Finally, a NiCd was left overnight on the zapper, and the "charging" LED was "on" the following morning. Eventually, four of these eight NiCds were recovered by overnight treatment with the zapper. Let the zapper do its job, and don't give up on the NiCds too soon. Four of them never recovered, even after 24 hours on the zapper. We set those aside.

All eight of the remaining NiCds were recovered. These were not as old as the eight described above, but they were 10 or more years old, and unkept for most of that time. These recovered in varying time. Some in a

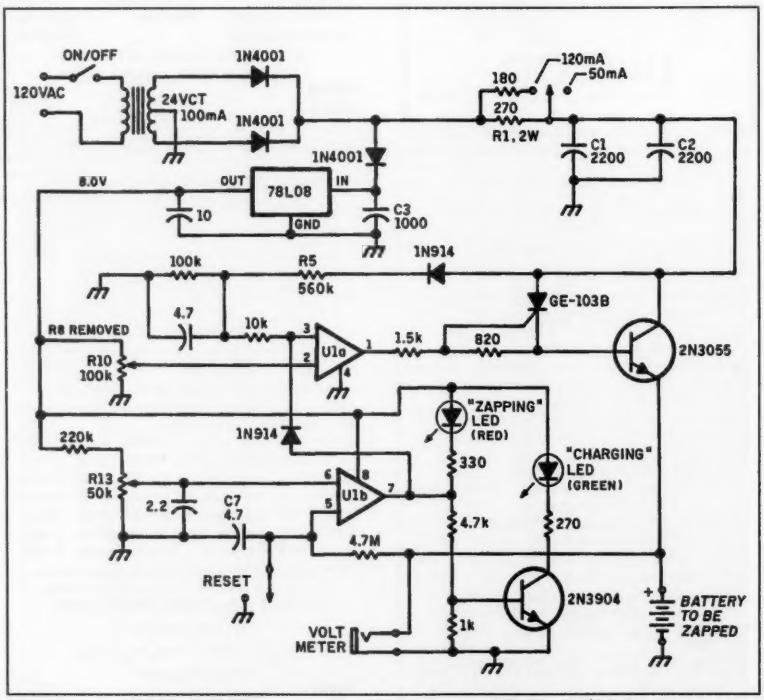

Figure 2. NiCd restorer from N7APE, as modified by WØDLQ.

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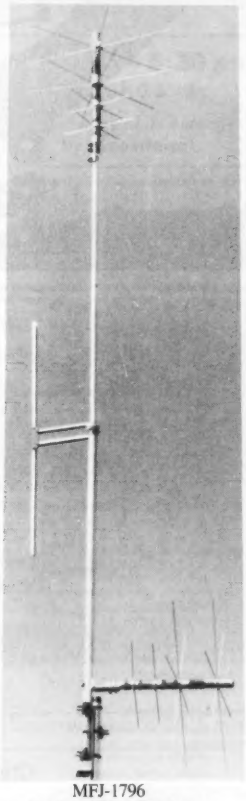

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matter of an hour or so, and a few required four or five hours to recover.

After recovery and charging, a number of the NiCds regrew their internal short. Some regrew the shorts while on a charger, unexpectedly. A short treatment on the zapper recovered these again, usually in minutes, instead of the overnight or several hours as initially required. All of those NiCds that initially regrew their internal shorts did so repeatedly. As they were re-zapped, it required less and less zapping time each cycle. It appears that with enough runs through the zapper they all might be fully recovered to hold a charge, although this has not been confirmed as of the writing of this article.

Several of the recovered NiCds displayed symptoms suggesting they had internal discharge paths, as opposed to internal shorts. This result exhibited itself when a zapped battery would recover in half an hour or less and would accept a charge, but would discharge to a low (not zero) voltage in less than 24 hours. About half to two-thirds of the 20+-year-old batteries had these symptoms.

More recently purchased NiCds (four to five years old) recovered nicely. I had only three NiCds in this category. They all recovered quickly and would hold a charge. No energy storage capacity test of these NiCds was done.

In recovery of old, shorted NiCds be wary of those that show unusually high or low voltages after charging. Experience suggested that those with fully charged voltages of more than 1.45 or less than 1.15 volts would eventually be "bad actors." They would either revert to internal shorts quickly, or would refuse to hold a charge for any significant time.

Note that the zapper will revert to the zapping mode if the NiCd voltage drops below the trip voltage set on pin 6. This allows you to leave a recovered NiCd in the zapper, and should it regrow its internal short while being charged, the zapper will automatically switch back to the zapping mode and re-zap the NiCd. This was observed a number of times on the 20+-year-old NiCds. This feature of N7APE's circuit was not recognized until it was experienced in practice. A nice feature indeed.

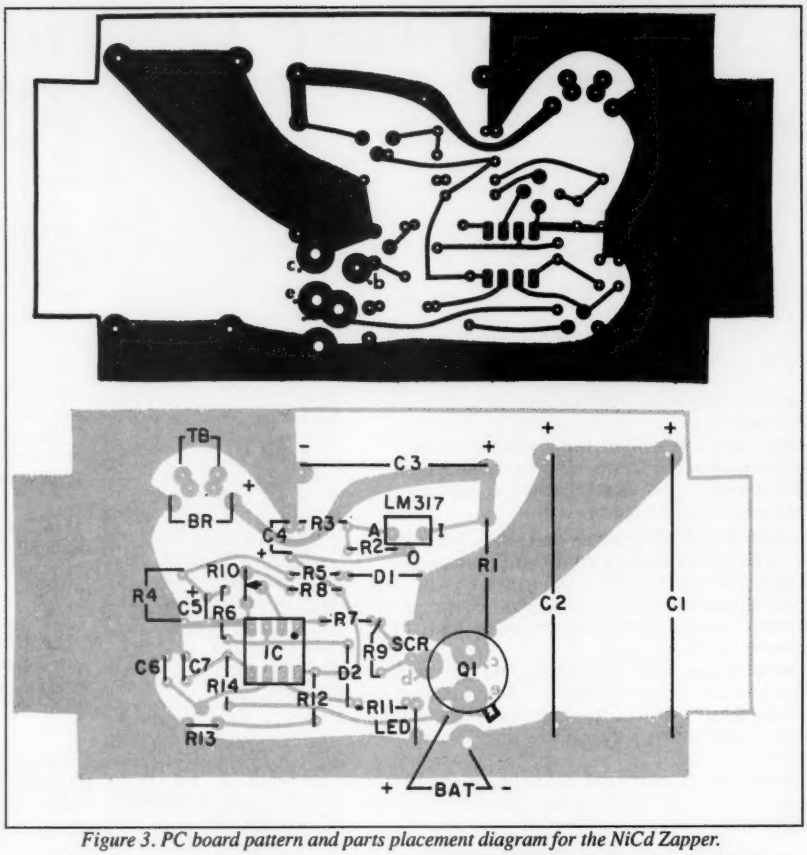

Figure 3. PC board pattern and parts placement diagram for the NiCd Zapper.

Checkout Sequence

1. Remove all power from the unit.
2. Discharge C1/C2, C4, C5, C6, and C7 completely by temporarily shorting them to ground.
3. Remove the LM358 IC from its socket.
4. Put a shorting jumper wire across C1/C2 to ground, and leave it there until step 10 below.
5. Turn on power and verify that the voltage at the regulator output is correct.
6. Verify that the voltage across C3 is at least 2 volts higher than the regulator output voltage. If not, the supply voltage must be increased, or the value of R1 must be increased.
7. Measure the the voltage across R1 (same as across C3) and calculate the current through R1. This current needs to be 50 mA for charging AA cells and 100-120 mA for charging C and D cells. If it is not correct, either the supply voltage or the value of R1 must be changed. The conditions of #6 above must still be met after any changes here.
8. Verify that pin 4 is at ground potential, and that pin 8 is at the regulator output voltage.
9. Adjust R13 for about 0.3 to 0.5 volts on pin 6, and set R10 to its midrange.
10. Turn off the power and remove the jumper from across C1/C1.
11. Discharge the capacitors as described in 1 and 2 above.
12. Put a shorting jumper across the battery box, insert the LM358 IC in its socket, and apply power.
13. The "charging" LED may flash very briefly, and the "zapping" LED should come on.
14. Connect a voltmeter across C1/C2 and adjust R10 for the maximum voltage on pin 2 that still lets the C1/C2 voltage ramp up and down, as seen on the voltmeter.
15. Remove the jumper at the battery box. After about five seconds the "zapping" LED should go off and the "charging" LED should come on.
16. Push the "reset" button. The "zapping" LED should come on immediately, and after about five seconds should go off and the "charging" LED should come on.
17. Re-connect the shorting jumper at the battery box. The "charging" LED should stay on for five to 10 minutes, or until the "reset" button is pushed.
18. See the text for information about optimizing the zapping energy.

NOTE: It is safe to verify the battery charge current via a mA meter at the battery box as long as the "charging" LED is on. But do NOT try to measure the current when the "zapping" LED is on!

Conclusions

The N7APE designed circuit works and works well. It does indeed recover internally shorted NiCds in a safe and effective manner. N7APE did the ham community a fine service in designing the zapper circuit. NiCds as old as some investigated here could not be permanently recovered. However, those NiCds of more recent vintage were successfully recovered. Any ham who uses NiCds should construct this device and put it to use.

Acknowledgments: Thanks to my friend Gene WØDLQ for building a zapper as I was building mine, and for numerous exchanges of ideas, comments, and discussions. Without his involvement it is unlikely I would have tackled this fun and useful project. And, of course, many thanks to N7APE for designing and publishing the circuit!

[Ed. Note: Reprints of the original article, "NiCd Restorer/Charger" by Ed C. Miller N7APE, are available for $3 each from 73 Amateur Radio Today, *70 Route 202 North, Peterborough NH 03458. Circuit boards for the original project are available for $5 plus $1.50 S&H from FAR Circuits, 18N640 Field Court, Dundee IL 60118.]*

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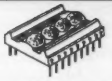

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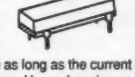

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CIRCLE 194 ON READER SERVICE CARD

Backup Battery Monitor/Charger/Alarm

Be prepared for emergencies.

by J. Frank Brumbaugh KB4ZGC

The well-equipped ham station has one or more deep-cycle storage batteries to provide operating voltage during interruptions of commercial AC power. Battery backup is invaluable during emergencies, natural or man-made, and allows operation when commercial power outages are local in nature—when wind, ice or other elements down power lines, affecting small areas.

Storage batteries require care and must be maintained at full charge so they will be available immediately when needed. While delivering power to operate modern 100 watt solid-state transceivers, storage batteries must not be discharged by more than 60% of their ampere-hour capacity or they may be damaged. Replacing deep-cycle storage batteries can be an expensive proposition.

Because modern solid-state 100 watt transceivers draw about 20 amps keydown, at even the 33 to 50 percent duty cycle of SSB or CW this will limit emergency operation to 10 to 20 hours maximum if 100 Ah batteries are used. Normal operation is considered to be 10 percent transmit and 90 percent receive.

These transceivers often will not function properly at low voltage, and storage batteries can be damaged if discharged too deeply, so it is advantageous to be able to tell the state of charge of batteries at a glance instead of having to check the specific gravity of each cell with a hydrometer. Also, a visual or audible alarm to warn when the battery has been discharged by 60 percent—only 40 percent charge remaining—alerts the operator to cease operation or risk permanent damage to expensive deep-cycle storage batteries.

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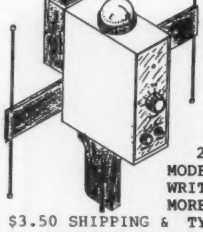
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scribed in this article will:

- Monitor the state of charge of station backup batteries.
- Maintain batteries at full charge, preventing overcharging.
- Provide a visual and/or aural alarm that warns of low battery voltage.
- Indicate voltage and current supplied to the transceiver.

Table 1. Battery Condition Meter Calibration

Lead-Acid Battery		Lead Calcium Battery	
Color	**Voltage**	**Color**	**Voltage**
Red	11.6 and below	Red	11.6 and below
Yellow	11.6-12.0	Yellow	11.6-12.0
Green	12.0-13.8	Green	12.0-13.5
Red	13.8 and higher	Red	13.5 and higher

The Circuit

See Figure 1. This project includes a voltage-limited regulated power supply operated from the AC line and provides up to 3 amperes to maintain the batteries at full charge. Charging voltage is constant at the normal full-charge level, so the charging current drops as full charge is approached, and full charge is maintained with a trickle current. This charging voltage can be adjusted between approximately 10 and 15 VDC to accommodate lead-acid (13.8V) or lead calcium (13.2V, 13.5V maximum) deep-cycle storage batteries.

A separate connection is provided so an external charger can be used when greater than 3 amperes is needed to charge a partially discharged battery. Any standard automobile battery charger can be used, setting the charging current at no more than 10 percent of the ampere-hour capacity of the battery. Internal circuitry will maintain the charging voltage to the battery at the nominal full-charge voltage level, regardless of the voltage supplied by the external charger, which will be 2 volts or more greater than that applied by the regulator to the storage battery. **WARNING: Do not fast-charge deep-cycle storage batteries!**

A pair of meters calibrated to indicate 20 VDC and 20 ADC full-scale monitor voltage and current provided to the rig when battery power is used.

A separate, suppressed zero, expanded-scale meter calibrated over the range of about 10 to 15 VDC allows immediate and constant indication of the state of charge of the station's backup battery. This meter scale is calibrated in bands of red, yellow and green, as explained in Table 1. The narrow yellow segment is based on the assumption that solid-state transceivers may not operate properly below +12 VDC. The internal power supply is used to calibrate this meter. A DMM should be used for greatest accuracy. Colored markers can be used to produce the multicolored scale.

An alarm circuit is included to indicate when the battery has been discharged by 60 percent to the 11.6 VDC level. When battery voltage is above 11.6, the green LED will be illuminated; when voltage falls to 11.6, the green LED goes out and the red LED lights. A piezo audible alarm sounds at this low voltage level unless silenced by the toggle switch controlling it.

A pair of fixed three-terminal regulators are included to provide +9 and +6 VDC for station accessories with outputs terminated in RCA jacks. An additional RCA jack provides regulated voltage from either the internal AC supply or the storage battery for accessories requiring this voltage.

Most small 12 volt relays have a coil resistance of 100-300 ohms and require 50 to 150 mA for operation. Because this current must flow through switch transistor Q4, the power dissipated is much higher than can be handled by any of the small signal transistors usually available (2N3904, etc.). Although at first glance it may seem

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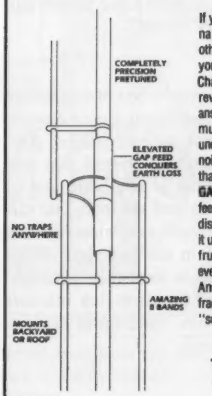

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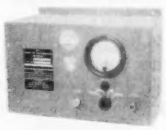
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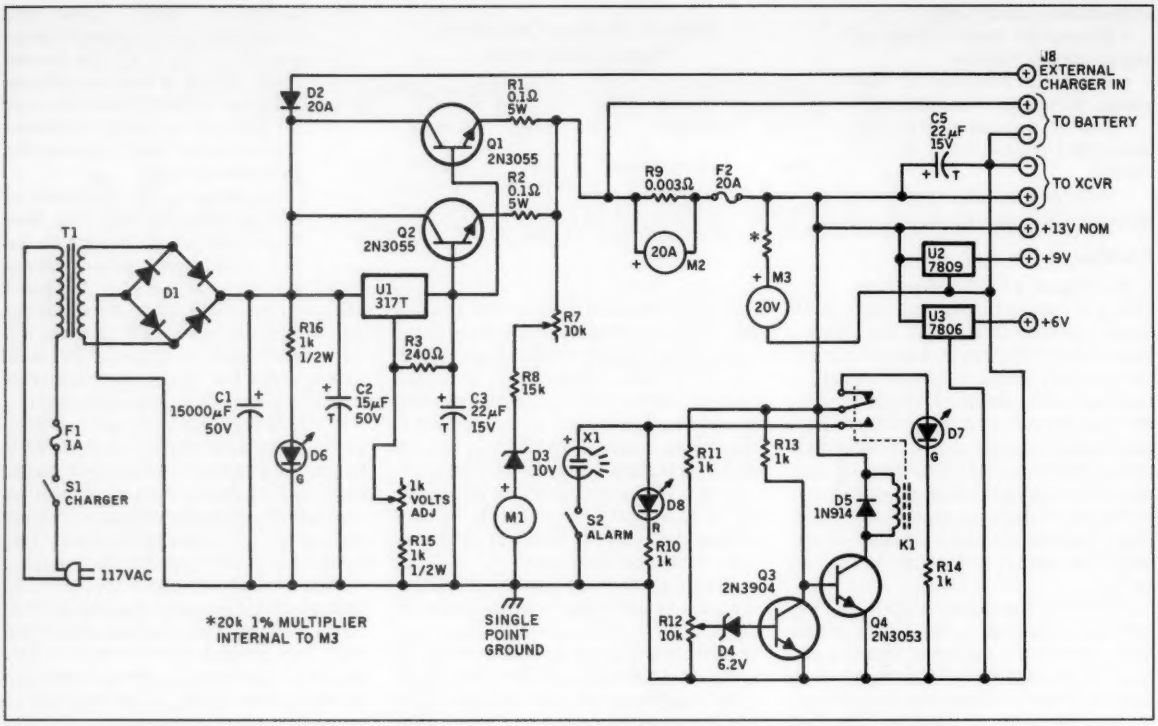

Figure 1. Backup battery monitor/charger/alarm schematic diagram.

wasteful to use a 5 watt VHF transistor (2N3053) as Q4, its power dissipation capability is necessary.

Circuit boards for this project are available from FAR Circuits (18N640 Field Court, Dundee IL 60118) for $9.50 plus $1.50 S & H. If you use PC board and mount transistors Q1 and Q2 onto the board, they must be heat-sinked. The transistors may be external to the board and wired back to the PC board.

Construction

This equipment should be constructed in a metal enclosure to present a neat appearance as a permanent item of station gear, but the actual layout and overall size will be a function of what is available and of each builder's needs and desires. The circuit is straightforward and many of the parts can be found in the junk box. What may not be on hand or available from other local hams or at hamfest flea markets can be obtained from mail order dealers, and from Radio Shack.

About Meters

The voltmeter and ammeter I used were originally 40-VDC meters. These 3-1/2"-square plastic-cased meters both had basic 0-1 mA movements and internal 40k multiplier resisters mounted inside. I took the meters apart, removed one 40k resistor and soldered it in parallel with the 40k resistor in the other meter, changing it to indicate 20 VDC full-scale. The remaining meter had the resistor replaced with a short piece of wire and then was a 1 mA meter which would require a shunt so it would indicate 20 amperes full-scale. By careful erasure of the numbers on both meter faces and use of a fine-tip felt pen to change the numbers, I calibrated both scales at 5, 10, and 20.

To make the shunt for the 20 ampere meter, I measured the resistance of the 1 mA movement (60 ohms) with a DMM. Ohm's law indicated that 0.06V across 60 ohms would cause full-scale current of 1 mA to flow through the meter movement.

I had some AWG-16 enamel-covered copper wire in the junk box, ideal for the shunt. Referring to a copper wire table, AWG-16 wire has a resistance of 4.016 ohms per 1,000 feet, or 0.004 ohms per foot and 0.00033 ohms per inch.

To determine the resistance needed for the shunt using Ohm's law, I divided 0.06V by 20A, resulting in a value of 0.003 ohms. Dividing this shunt resistance by the 0.00033 ohms resistance of one inch of AWG-16 wire indicated that a length of nine inches of AWG-16 wire was needed for the 20 amp shunt. I temporarily wound this length of wire, plus 1/2" at each end for connections, on the body of a felt-tip marker to make a small coil and then removed it and connected it across the 1 mA meter. Violà! A 20 amp meter!

Your meter movement may be different, but the method for determining the proper shunt will be the same, as explained above.

The voltmeter multiplier resistance, if needed, can be determined by applying 20 VDC, if you have it, across a series circuit consisting of the meter and a potentiometer of at least 25k ohms for a 1 mA movement. (Less resistance will be needed if your meter is 5 or 10 mA or more, but greater if a more sensitive meter—50, 100 or 200 µA—is used.) Set the pot at maximum resistance and then adjust for a full-scale indication on the meter. Remove the voltage and measure the resistance in that portion of the pot in the circuit at full-scale. This is the value of the multiplier resistor for a 20 VDC full-scale indication. A trimpot and a series resistor used as the multiplier will allow accurate calibration of full-scale voltage.

If you do not have a source of 20 VDC, you can use 15V for three-quarter scale or 10V for half-scale indication. The amount of resistance will be the same.

The battery condition meter (M1) is a suppressed zero, expanded-scale DC voltmeter set by external components to cover an approximately 5 volt range between 10 and 15 VDC. Refer to Figure 1. The 10 volt zener diode (D3) suppresses the zero so the meter will not begin to indicate until at least 10 volts are applied to its cathode. Between this point and +15 VDC, as established by the multiplier resistor (R7 and R8 in series), the meter becomes a 5 VDC meter, indicating only that segment between 10 and 15 VDC.

Although this same range is obviously indicated on the 20V meter (M3), the 5V range covering from below fully dis-

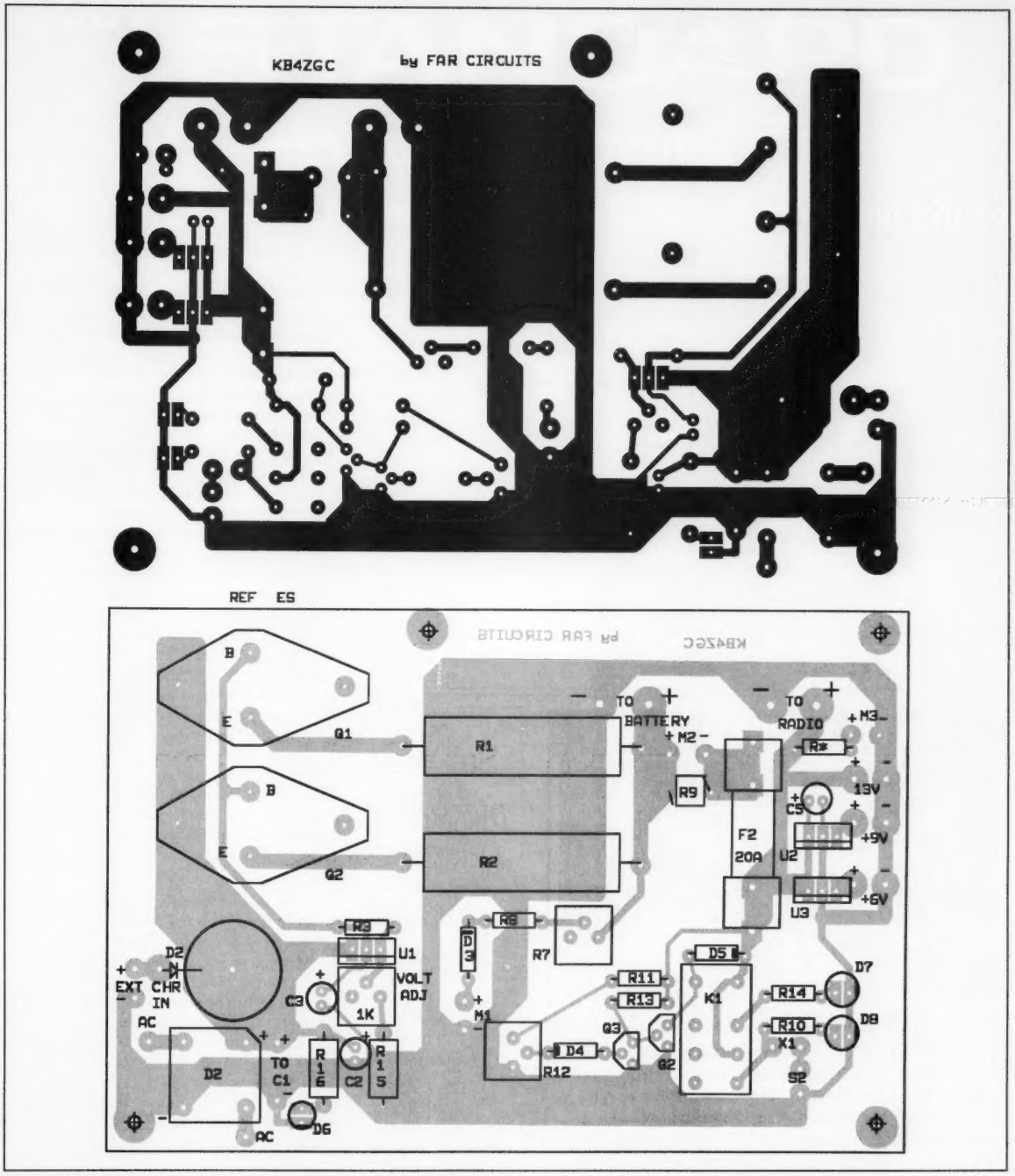

Figure 2. Circuit board and parts placement for the Backup Battery Monitor/Charger/Alarm. Note: If transistors Q1 and Q2 are mounted on the PC board, they must be heat-sinked. The transistors may be external to the board and wired back to the PC board.

charged to above fully charged condition of the storage battery is expanded over the full scale of the battery condition meter M1, making voltage (and charge level when calibrated) changes much easier to see.

The resistance of the meter multiplier I used was based on the 265 μA full scale deflection of the small surplus meter I used. Depending upon the full-scale current of your meter, the multiplier resistance can be determined, as explained above, for 5 VDC full-scale indication.

Final Adjustment

Apply AC power and set output voltage at 11.6 VDC, using a DMM for accuracy. Adjust R12 so the green LED D7 just extinguishes and the red LED D8 is illuminated. Operate S2 to check operation of the piezo aural alarm.

Increase output voltage to 13.8 VDC (lead-acid battery) or 13.5 VDC (lead calcium battery). Note that as output voltage is increased, the red LED D8 extinguishes and the green LED is illuminated. Now remove the power.

Parts List

C1	15,000 µF, 50V electrolytic
C2	15 µF 50V tantalum
C3, C5	22 µF 15V tantalum
C4	0.01 µF disc ceramic
C6, C7, 8	0.1 µF 16V disc ceramic
D1	6A bridge rectifier
D2	20 ampere stud diode
D3	10V zener diode
D4	6.2V zener diode
D5	1N914, 1N4148, etc.
D6, 7	Green LED
D8	Red LED
F1	1 amp fuse
F2	20 amp fuse
J1, J2	2-terminal barrier strip, 25 ampere capacity
J3, J4	Binding posts, red and black
J5, J6, J7	RCA jacks (optional)
J8	Insulated terminal post
K1	12-VDC relay, SPDT
M1	Surplus meter, 200 uA to 1 mA
M2, J3	0-1 mA DC meters
Q1, Q2, J2	2N3055 (on large heat sinks)
Q3	NPN small signal transistor (2N3904, 2N4124, 2N2222, etc.)
Q4	NPN 2N3053 (see text)
R1, R2	0.1 ohm, 5W
R3	240 ohm, 1/4W, 5%
R4	1,000 ohm pot, screwdriver adjust
R5, R6, R10, R14	1000 ohm 1/4W 5%
R7, 12	10k ohm trimpot
R8	15k ohm 1/4W 5%
R9	20 ampere shunt (see text)
R11, R13	1,000 ohm 1/4W 5%
R15, R16	1,000 ohm 1/2W 5%
S1, R2	SPST toggle or slide switch
T1	18-25 VAC secondary, 3A transformer
U1	LM317-T adjustable regulator
U2	7809 regulator (9 VDC) 1 amp
U3	7806 regulator (6 VDC) 1 amp
X1	Piezo alarm buzzer, 12-VDC

Pre-etched and drilled circuit boards are available from FAR Circuits, 18N640 Field Court, Dundee IL 60118, for $9.50 plus $1.50 S & H.

Connect J1 to the battery positive terminal and J2 to the battery negative. Also connect J2, or the negative terminal of the battery, to the station DC ground. Note the indication on the battery condition meter (M1)—it should be in the green area above 12 VDC. Apply power while watching ammeter M2. If 3A or less are indicated, the battery can be left on trickle charge.

If the battery condition meter M1 indicates low in the green or yellow area, do not apply power or you may blow the primary fuse or overheat the transformer. Instead, connect the positive lead of an external battery charger of the type used to charge automobile storage batteries to J8 and the negative terminal to the negative terminal of the storage battery. Set the charger for an indication on ammeter M2 of not greater than 10 percent of the battery's ampere-hour capacity—10A for a 100 Ah battery, for instance.

Note that the voltmeter M3 and the battery condition meter M1 indicate full charge for the type battery you are charging, and that D7 is illuminated.

Ignore the indication on the battery charger voltmeter if one is provided. It will indicate somewhat higher voltage than is required for a fully-charged battery, but the internal regulator in this equipment will hold the voltage applied to the battery to the proper level and will not allow the battery to be overcharged. Charging current will gradually be reduced as the battery accepts the charge, eventually tapering off to a trickle: under 1 ampere. At this time, or at any time thereafter, the external charger can be disconnected and the power applied to this equipment and it will then maintain the battery fully charged for use whenever needed.

Conclusion

The large-capacity deep-discharge storage battery used for backup power in the station represents a sizable investment. When properly maintained and used, it will provide satisfactory service for many years. Building and using this simple equipment will ensure that power will be available when needed. With the battery fully charged and connected to this equipment, which should be powered from the AC line and turned on at all times, no further attention is required.

However, as with any storage battery in backup service, monthly hydrometer readings should be taken of each cell and recorded, in accordance with the battery manufacturer's instructions. Water which may be evaporated from the battery over time should be replaced when necessary with *only distilled water*, available in numerous supermarkets and drug stores throughout the country.

WARNING: Do not use tap water or any bottled water except distilled water or the battery may be damaged or its capacity to hold a charge reduced.

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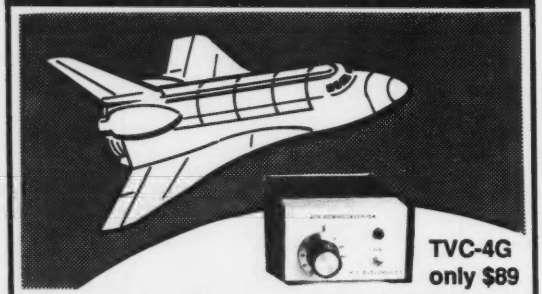

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CIRCLE 122 ON READER SERVICE CARD

Number 10 on your Feedback card

by Bill Clarke WA4BLC

HF/VHF Digital MFJ SWR Analyzer

MFJ Enterprises, Inc.
P.O. Box 494
Mississippi State MS 39762
Telephone: (800) 647-1800
Price Class: $199.95

Over the past two years I have reviewed MFJ's SWR analyzers as they progressed through the evolution process. The first version required the use of an HF receiver for accurate frequency setting (or the use of a portable frequency counter). The next version included a built-in frequency counter that displayed the frequency as you tuned for lowest SWR. Both units were designed for operation in the HF area of 1.8 through 30 MHz.

The most recent MFJ SWR analyzer brings VHF capabilities. The MFJ-249 HF/VHF SWR Analyzer covers all frequencies from 1.8 through 170 MHz. If this device doesn't become one of the handiest helping hands around the shack I don't know what will.

What is an SWR Analyzer?

An antenna analyzer is used to accurately determine the SWR of an antenna at the shack feedline, antenna, tuner, or any point in between. No transmitted signal is required during measurements. This means no on-the-air tune-ups, something most of us wish would go away anyway. Adjustments to the antenna can be made while the unit is hooked up to the antenna, thereby giving instant results of adjustments.

Measurements are made by use of a variable frequency oscillator, an SWR measuring circuit, and a digital frequency display.

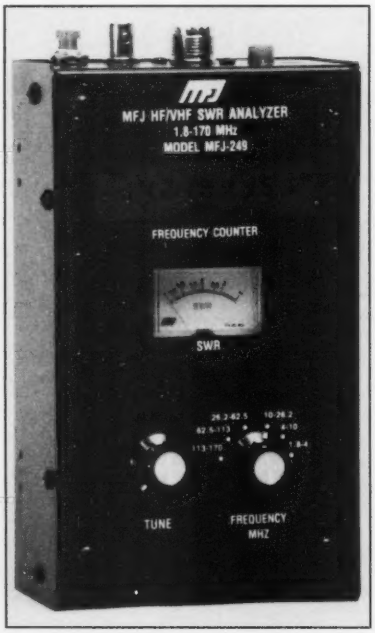
Advantages of a Small Unit

The MFJ-249 is completely portable for use in the field or in the shack (it operates on six AA batteries or an external AC supply). It can easily be used at ground level for verticals, on a tower for a directional antenna, and at any other antenna's feed point. Antenna SWR can be checked without returning to the shack.

In the shack, the SWR of your feedlines can be checked. After all, this is the SWR your transceiver will operate into.

Using the MFJ-249

First and foremost, read the manual before you use the analyzer. Although it is quite simple to operate, the analyzer can be damaged by improper use. The manual is



small, but it points out proper procedures that will assure correct usage. Probably the most important warning the manual gives is: DO NOT TRANSMIT INTO OR THROUGH THE ANALYZER.

The manual includes some general information about coax feedline losses and explains how high SWR increases these losses. It recommends further reading in the *ARRL Antenna Book.*

A sample SWR antenna plot chart is included, which can be copied for your use. Graph paper (my personal choice is 1/4-inch scale) works well for plotting, also.

In the Shack

I connected the analyzer to the various feedlines in my shack and tested each for the frequency of lowest SWR. I then made a record of this information for future reference. I also checked this newest set of readings with those of a year ago. All was still in order.

As a matter of curiosity, I now know why one of my 2 meter antennas has never worked very well. The lowest SWR point is at 142.205 MHz and, unfortunately, the antenna is a sealed unit and not adjustable. Without the VHF capability of the new unit I could not have easily determined this.

I made a plot of the Cushcraft R5 (new last summer) and confirmed that no changes had occurred since installation. Interestingly, however, I found a large number of low SWR points between 60 and 115 MHz.

A couple of 2 meter HT antennas were checked and found to have SWR low points a little above the band. I have tried this test via other means in the past and observed similar results. It's interesting to watch the effect caused by objects in close proximity to these little antennas. When I waved my hand within a few inches of them the SWR would change from 1.2:1 to off the scale.

Have a feedline in the shack and not sure what it does? Just connect the analyzer and see where it operates.

Building and Adjusting a 75 Meter Dipole

The scenario for building a dipole antenna and using the analyzer for adjustments is quite simple. Using the formula 468/frequency in MHz, a leg length of 60 feet each is determined. Note that few antennas will be exactly formula length, due to the environment in which they operate (i.e. proximity to power lines, other antennas, buildings, aluminum siding, etc.). For this example, the dipole legs are cut to 64 feet each (somewhat oversize, for adjustment purposes). Assemble the antenna using a center insulator as a feed point and haul it into place with a feedline attached.

Connect the analyzer to the feedline and check for the frequency of lowest SWR. In this case it is 3.585 MHz. As the antenna is meant to operate at about 3.9 MHz, some leg pruning will be necessary.

Leaving the analyzer connected, drop the antenna and prune 6 inches (12 inches at a time is OK until within 100 kHz of the desired frequency) from each leg and recheck for the frequency of lowest SWR. Repeat this process until the frequency of lowest SWR is within 25 kHz of the desired point. This completes the adjustments. Remove the analyzer and run the feedline to the

shack for use. By the way, it is not uncommon to be unable to reach an SWR of 1:1. However, 2:1 and below is quite acceptable for most purposes.

Note that the amount pruned from the legs must be equal on both sides. Additionally, when working on higher frequency antennas, you must prune less at a time. For example, on 17 meters a couple of inches at a time is appropriate.

In general, when the lowest SWR frequency is higher than desired, the elements (dipole legs in this case) are too short. If the frequency is below that desired, the elements are too long.

The advantages of antenna adjustments made in this manner are reduced QRM and the convenient lack of running back and forth between the shack and the antenna.

Antenna Tuner Adjustment

Want to eliminate another tuner-upper from the band? I sure wish everyone would! It's simple—just connect the analyzer to output #2 of a two-position self-grounding coax switch and your transceiver to output #1. The common output is connected to the input of your tuner.

To adjust the antenna tuner, select position 2 on the coax switch, set the analyzer to the desired frequency, and adjust the tuner until the SWR meter reading is at its lowest point. All this is done with no transmitted signal. Lastly, select position 1 on the coax switch and you are ready to transmit.

Frequency Counter

The MFJ-249 can be used as a frequency counter over its entire operational range. As with its predecessor, the 247 is not very sensitive and requires the use of a "times 1" probe for all but the most basic of frequency checks. However, all you have to do is put a rubber duck on the BNC connector and it's great for checking 2 meter mobile rigs and HTs. The readout is selectable from four to six decimal places.

Recommendation

Following the evolution of the MFJ SWR analyzers has been very interesting. They have all proved to be very useful and the MFJ-249 is the best yet. Having coverage from 160 through 2 meters is a definite advantage over the older models. For operational convenience, the SWR meter has been moved to just below the digital display and the non-sensitive controls moved to the top of the unit.

The MFJ-249 makes antenna work of all kinds easier, from tuning simple dipoles to adjusting traps on a triband beam to fine tuning HF mobile antennas. The analyzer is certainly a must-have device for Field Day, and with 2 meter capabilities it makes VHF mobile antenna adjustments a snap.

Since their inception, I have used MFJ SWR analyzers and would never go back to the old-fashioned method of transmitting a signal, taking a reading, going out to the antenna and making an adjustment, returning to the shack, transmitting a signal, taking a reading, repeating, repeating, repeating! Being able to make all the necessary adjustments without returning to the shack is wonderful. As an extra carrot, I make no QRM while tuning my antennas. 73

Specifications

Dimensions	4" x 6.8" x 2.2" (WHD)
Frequency	1.8-170 MHz
Power	12 VDC @ 300 mA
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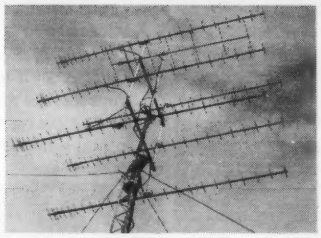

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RA8-2UWB	144-148MHz	8el	11.8ft	11.2 DBd	91.75
FO12-144	144-146.5MHz	12el	17.3ft	12.6 DBd	142.50
FO12-147	145-148MHz	12el	17.3ft	12.6 DBd	142.50
FO15-144	144-145MHz	15el	25.1ft	13.8 DBd	192.50
FO16-222	222-225MHz	16el	17.3ft	14 DBd	129.95
FO22-432	432-438MHz	22el	14ft	15.8 DBd	114.95
FO22-ATV	420-450MHz	22el	14ft	15.8 DBd	114.95
FO25-432	432-438MHz	25el	17.1ft	16.5 DBd	134.95
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Number 11 on your Feedback card

by David Cassidy N1GPH

US Digital Company's DVR 501A Simplex Repeater System

US Digital Co.
380 Rougeau Ave.
Winnipeg, MB
Canada R2C 4A2
Telephone: (204) 661-6859
Price Class: $166

In the last few years, low-cost microchips that are capable of recording digitally have become available. Several companies have come out with products utilizing these chips in such things as contest voice recorders, repeater IDers, repeater voice mailbox systems, and what is called a "simplex repeater." Until recently, simplex repeaters have been mostly large and costly boxes, but US Digital Co. (strangely, a Canadian company) has released a palm-sized simplex repeater that works amazingly well for the price.

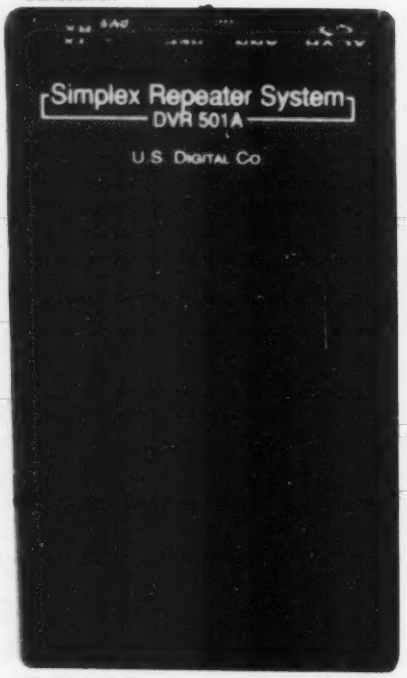
What's a Simplex Repeater?

A simplex repeater records a transmission, then rebroadcasts the recorded transmission on *the same* frequency. If you place the simplex repeater in a good location, low-powered stations are able to communicate over much greater distances, as long as you wait for the repeating of your transmission. One situation that springs to mind where a simplex repeater would be useful is in emergency rescue work, especially in remote and mountainous areas. Drive your simplex-repeater-equipped car to a high spot (or, in *very* remote areas, air-drop a simplex-repeater-equipped package), and everyone involved in the search will be able to communicate without the need for a manned relay station. Those involved with this type of communications might want to leave a simplex repeater permanently wired into their mobile rig.

There are other uses for a simplex repeater. You can set it up in announce mode so that instead of repeating whatever is heard, a pre-recorded message is broadcast at a pre-determined time interval. This would be useful as an automatic IDer, a low-cost way of adding voice announcements to your club's repeater, a way to test your own station's quality, a propagation beacon, or in dozens of other situations.

US Digital's DVR 501A

US Digital has come out with the smallest simplex repeater available. The entire unit fits into a case that easily disappears in a shirt pocket. The unit is powered by a standard 9 volt battery, and comes complete with a pre-wired cable that is suitable for use with ICOM or Yaesu HTs (if you've got an Alinco, Azden, Kenwood or other HT, a little rewiring of the plugs is all it takes). The repeater simply plugs into the microphone and speaker jacks. It's a simple matter to wire up additional plugs to make the unit function with any other transceiver.



US Digital Company's Simplex Repeater System, shown at actual size.

All connections and the single mini-switch are on the top of the well-made black plastic case. The case is *so* tight that I had a little trouble sliding the battery compartment cover back on after installing the battery. Once I was successful, no amount of squeezing or shaking produced the slightest sound or movement. This case is solid! The mini toggle switch is used to choose between repeat and announce modes. There are also two LEDs to indicate when a signal is being received or transmitted.

Once you have the Simplex Repeater System connected to your transceiver and switched to repeat mode, anything that is received will be recorded and immediately rebroadcast. The digital recording chip that is the heart of the simplex repeater provides exceptional audio quality with a 3.2 kHz passband.

To set up the announce mode, you start in repeat mode. The announce mode takes the last message recorded in repeat mode and continues to broadcast it approximately every seven minutes. This means that you need two radios, one with the DVR 501A wired in, and another to send the announce message. After the message is recorded in repeat mode, you move the toggle switch over to "announce." The DVR 501A will now rebroadcast the message until you switch it off or back to repeat mode (or until the battery gives out).

In Use

The small size and battery power of the US Digital Simplex Repeater System brings one particular use immediately to mind: With this unit and an HT, you've got an instant, easily-hidden transmitter for your next foxhunt.

While I wasn't able to use the US Digital unit in an actual foxhunt, I found many other uses for this little box. Instead of keying up your local repeater over and over again to test that new VHF or UHF beam, a simplex repeater wired into your home station allows you to get a signal on demand from any line-of-sight location. I recently attended a hamfest where the sponsoring club used a simplex repeater to broadcast directions from all the major local highways. They set it up on a 2 meter simplex frequency, and it ran all weekend without a flaw.

US Digital's little simplex repeater is one of those gadgets that you never thought you needed, but after you get one, you wonder what you did without it. Its low cost and small size make it even more versatile.

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PACKET & COMPUTERS

Jeffrey Sloman N1EWO
75 Herriott Street
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This column will be a break from the continuing series on asynchronous communications. I don't do this lightly, since I have gotten a lot of positive feedback on the series. I chose to take a break because it has become clear that I need to write something else first.

Those of you who receive *Radio Fun* have seen my column in that publication. Since *RF* is targeted to a beginning audience I have written about the operations aspects of packet, and packet etiquette in particular. After discussions with sysops and users, I have decided that the readers of this column also need some information on this very important subject.

The Problem

There are many packet operators who are technically savvy. They have no problem whatsoever in setting up their stations, and are often heard on the local repeater offering useful advice to those trying to get started in packet. These operators are a valuable resource to packet—no question about it. Unfortunately, you will rarely hear these same hams helping others with their operating practices, and the abuse of the (inter)national packet network has become a critical issue.

The loosely composed network of stations that comprise the system we depend upon to forward packet messages throughout the US is being swamped by frivolous, redundant, and sometimes even illegal traffic. Personally, I don't believe that the hams who are causing the problem are doing so intentionally—I think it is ignorance at work. This, coupled with a lack of local instruction for beginners at packet, is what has lead me to write this column.

Illegal Messages

I'll start with the most problematic class of mistakes—messages that cross the line of legality. These messages threaten the existence of automatic forwarding as sysops (SYStem OPerators) decide that it is not worth the risk to their license to forward messages that contain traffic contrary to FCC regulations, and that it takes too much time to manually check the content of each message that passes through their systems. (Note: The ARRL is currently trying to solve this problem by changing the regulation to make it clear that the sysop is not responsible for the content of forwarded messages—a reasonable interpretation of the current regulations. This is a good idea, but the problem should be eliminated at the cause: the sender.)

These questionable or outright illegal messages are almost always "for sale" messages. In fact, "for sale" messages are responsible for many of the problems faced by the packet networks. The most troublesome of these messages are those that seek to sell non-ham-radio items. This is not allowed by FCC regulations. Anything offered for sale on ham radio, be it by voice, packet, or any other mode, must be directly related to ham radio. Here is the problem: A recent informal survey of a week's traffic on a local PBBS (Packet Bulletin Board System) showed that about 75% of the messages were of the "for sale" variety. Of these, more than 50% were about computer equipment—including parts, components, and complete systems.

Now, I *know* that a computer can be used as part of a packet station, and parts like floppy drives and SIMMs (Single In-line Memory Modules) can be used in computers, *but these are not ham radio gear.* They have many other possible uses. A Kenwood 450-S, as a contrast, is obviously a piece of ham gear. The use of the packet network as an over-the-air computer swap meet has two obvious negative consequences. First, it creates a potentially hazardous situation for sysops, should the Commission decide to interpret the rules in an unfavorable way. Second, it clogs the network with traffic better left to landline BBSs, which are prevalent and readily available throughout the country. The bottom line on this type of traffic is that unless you are selling

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a complete station—TNC, computer, and radio—it would probably be better to pass on packet as a method of advertising it.

Just Plain Silly

It is my own opinion that "for sale" traffic does *not* enhance the value of the packet network. However, I have talked with many hams who enjoy reading and responding to such messages. I am not here to tell you to stop trying to sell your ham radio gear via packet. On the other hand, if you are going to use packet to sell gear, please *think* before you do. When you see a message addressed to ALL@ALLUSA advertising a 70-foot crank-up tower—*you take it down*—you know that the sender:

A. Doesn't care about wasting bandwidth by sending his message to every BBS in the country when his tower could not be of interest to anyone outside of driving range of his QTH; or

B. Doesn't care enough to learn to address his message to just that area.

Reason A is just plain rude and reason B is not an excuse. If you are going to send a "for sale" message, start local, give it a chance, then make a wider distribution. Yes, this is harder on you than sending an ALL@ALLUS message, but it is also courteous operation. Very frequently the item is sold to a local ham before the message even gets a chance to be forwarded outside your local area, anyway. If you are selling something that cannot be shipped, keep your traffic local. If you are selling something that is in demand, likely to sell quickly, keep your traffic local.

How do you address traffic to your local area? Each area has its own addresses that divide it up. The sysops in your area have these designations in their forwarding files so that traffic is distributed appropriately. If you don't know the address(es) for your area, leave a message for the sysop on your local PBBS asking. I am sure that he or she will be happy to provide the information. You may even be able to tell by looking at the traffic on the PBBS, since some of it is bound to be addressed to the local area.

More on Addressing

The idea that traffic should be addressed more selectively is not unique to "for sale" messages. Before you send ANY message, think about how it should be addressed. If you have a technical question about an AEA PK-232 MultiMode Controller—a *very* common unit—don't send your message to ALLUS! It isn't necessary. You are guaranteed to find the answer in your own state, probably your own town. By sending it to ALLUS, you just add to the burden of the already overburdened packet network.

On the other hand, if you have discovered a modification to the PK-232 that improves its AMTOR performance, and you want to share it, send it to something like PK-232@ALLUS. This is a perfect way to use ALLUS forwarding since it is a piece of technical information of use to all PK-232 enthusiasts. Notice, too, that I did not suggest addressing it to ALL, but to PK-232. This way, potentially interested hams will spot the message and will be able to use your wonderful new mod.

What's in a Name?

This brings us to message titles. If you have a good address—like in the example above, PK-232@ALLUS—then you just need to top it off with a good message title. The point of the address and title of the message is to make sure that it gets to the right person. To accomplish this, the three parts must work together to get the traffic to its destination and then to engage the interest of the person you want to reach. Messages addressed to ALL@ALLUS, with titles like "handhelds" just don't cut it. To complete the example from above, we might try something like:

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You can see where this kind of information will get it to your potential reader, and then entice them to read the message. Remember: You have 30 characters to work with in the subject line—use them well.

So, with a little thought and some desire to do the right thing, *you* can help make our packet networks a better place to operate. Cleaning up your packet act *will* help make a difference to everyone with whom you share the bandwidth of the packet network. Please, try to make a difference.

Next time we'll get back on track with our multipart series and I'll have some preliminary survey results. Till then, 73 de N1EWO.

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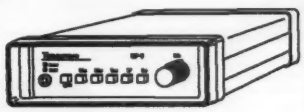

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Using Operational Amplifiers

Operational amplifiers (op amps) were invented prior to the Korean War for use in analog computers; it's the math operations from analog computers that is meant by the term "operational." Interestingly enough, if you were to see the original Philbrick book on designing with op amps (copies are still in dusty book racks in college science departments, I am told), the circuits would look very much like those in modern op amp books. In this month's column we are going to look at the basic op amp circuits that are used in ham radio applications.

What are those applications? Well, the first that springs to mind is microphone preamplifiers. Also, you find these neato circuits in active analog filters, and in instrumentation circuits. Examples of the latter are Wheatstone bridges and antenna bridges where the minute DC signal produced across the detector can be amplified for display on an analog meter.

Figure 1 shows the basic circuit symbol for an op amp. The pin numbers given are for the popular 741 device, and this is considered the industry standard for a large number of products. Before hooking up some unfamiliar op amp, however, check the data sheet to see if it uses the "standard" pinouts.

There are two inputs on this device: -IN is the inverting input and produces an output that is 180 degrees out of phase with the input signal; +IN is the noninverting input and produces an output signal that is in phase with the input signal. Taken together, the -IN and +IN form a differential pair, i.e. allows us to build a differential amplifier. The output is single-ended with respect to ground.

Note that there are two DC power supply connections, and that neither of them is ground (see the inset for the typical op-amp power supply configuration). The V+ power supply is positive with respect to ground, while the V- power supply is negative with respect to ground. Some op amps also use either pins 1 and 5 or 1 and 8 for offset nulling or frequency compensation.

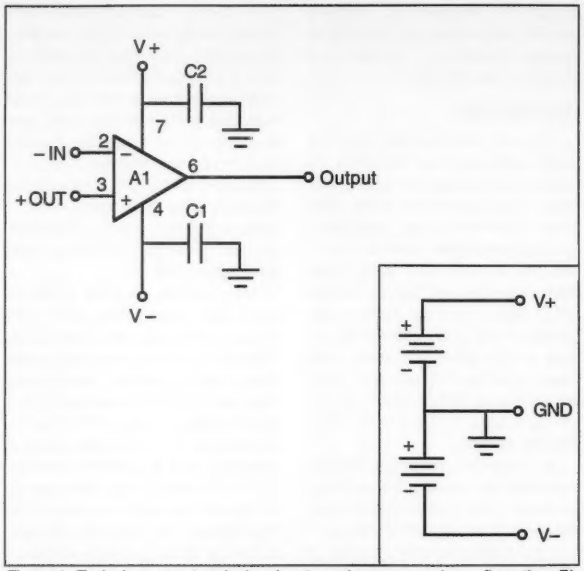

Figure 1. Typical op amp terminals, pinouts and power supply configuration. Pin numbers shown are the "industry standard" pinouts, and are from the 741 device. Check data sheet for any op amp other than 741, however, before connecting.

Op amps have very high open-loop (without feedback) gain (greater than 250,000 is typical). They therefore can be expected to oscillate all too easily. Even so-called "frequency compensated" or "unconditionally stable" op amps have been known to be rude enough to spuriously oscillate under the correct circumstances. Not good. As a result, most authorities recom-

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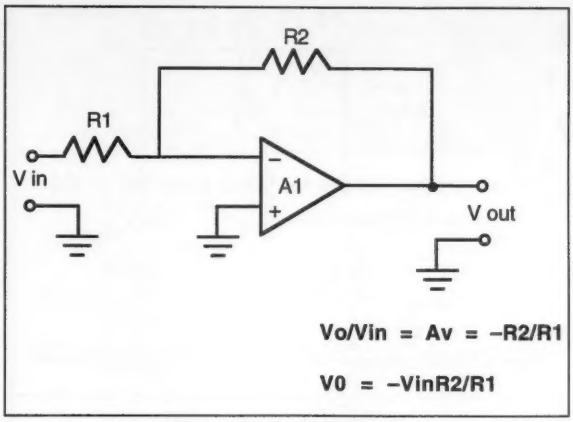

Figure 2. Inverting follower circuit.

mend that the power supply pins be decoupled with capacitors that have a value that will produce a very low reactance path to ground. In most cases, a value from 0.1 µF to 4.7 µF is used for C1 and C2.

Note that in Figure 1 there is no ground connection on the body of the op amp itself. Input and output signals are ground referenced, but the only ground *per se* is in the DC power supply circuit (see the inset to Figure 1).

In most of the circuits in this article you will find the DC power supply terminals deleted. That is done for graphic simplicity, but in really-working circuits you would connect V- and V+ as per Figure 1.

Inverting Followers

Figure 2 shows the *inverting follower* amplifier circuit. This circuit produces an output that is 180 degrees out of phase (i.e. "inverted") with the input signal. Thus, $V_o = -A_v V_{in}$, the standard notation (A_v denotes "closed loop voltage gain"). The value of the voltage gain is set by the ratio of the resistors in the feedback loop:

$$A_v = -\frac{R2}{R1}$$

The "-" sign in the equation denotes phase inversion taking place. The output voltage, as a function of the input voltage and gain, is therefore:

$$V_o = -V_o\left(\frac{R2}{R1}\right)$$

For example, let's assume that we want a gain-of-100 amplifier with an input impedance of at least 10k ohms. We therefore set input resistor R1 to 10k ohms (or higher), and then calculate the value of R2 that produces an A_v of 100:

R2 = R1A_v = (10k ohms) (100) = 1,000,000 ohms

For situations where gain is desired, make R2 greater than R1, but if you want to attenuate a signal make R2 less than R1. When R1 = R2 the gain is unity (1), and when R2 is a potentiometer the gain is 0 to 1.

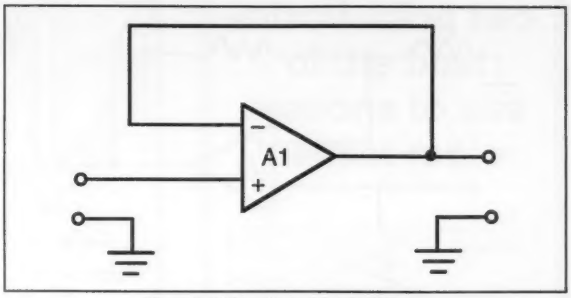

Figure 3. Unity gain noninverting follower.

Noninverting Followers

The noninverting follower produces an output signal that is in phase with the input signal, and comes in two varieties: unity gain (Figure 3) and greater-than-unity gain (Figure 4). The unity gain follower is used for buffering, isolating and impedance transformation. It gets the latter job from the fact that it has a very high input impedance and a very low (less than 100 ohms) output impedance.

The greater-than-unity configuration of Figure 4, like the inverting fol-

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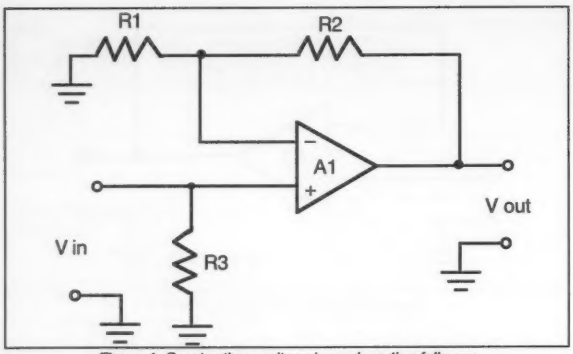

Figure 4. Greater-than-unity gain noninverting follower.

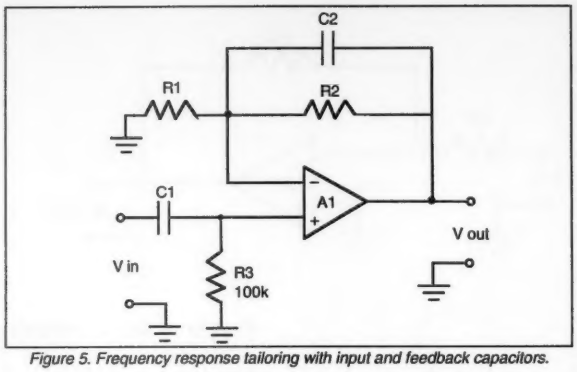

Figure 5. Frequency response tailoring with input and feedback capacitors.

lower case, is a feedback network consisting of R1 and R2, but in this case the input resistor R1 has the "input" end grounded. The input signal is applied between the +IN terminal of the op amp and ground. In some cases, an extra resistor (R3) is used between +IN and ground in order to keep the output from saturating when the input line is opened. This situation occurs, for example, when the signal source is disconnected . . . as in when the microphone is removed from its jack.

The gain equation for the noninverting follower is a bit different from the inverting version, but is similar:

$$A_v = \left(\frac{R2}{R1} + 1\right)$$

Note the absence of the "-" sign. It's not needed because the gain here is noninverting. The gain is one more than the resistor ratio. For low gains the extra "1" makes a large difference, but at high gains it is only a small error. For example, at a resistor ratio of 10:1 the gain is 11, and the difference between 10 and 11 amounts to 10 percent. But at a resistor ratio of 100:1 (as in the above example worked out) the gain is 101, so the error is only 1/100 or 0.01 (i.e. 1 percent). This little tidbit is not terribly useful unless you are stuck with standard value resistors. For making a gain-of-100 amplifier we can either find a 990k ohm resistor, or use the 1 megohm resistor and accept a 1 percent gain error.

Frequency Tailoring

Frequency tailoring is used in practical circuits to limit the signal spectrum, to limit noise, and to prevent the amplifier from oscillating. Capacitors can be used in simple op amp circuits to limit the frequency response. Consider Figure 5, a noninverting gain follower. The low end frequency response is limited by the combination of the input resistor R3 and capacitor C1. The -3 dB point is set by:

$$F_{-3dB} = \frac{1}{2\pi R3\,C1}$$

For a microphone preamplifier, where the frequency response is typically set to 300-3,000 Hz, the combination of C1 and R3 would be set to 300 Hz or thereabouts. A combination of 100k ohms and 0.005 uF would do the trick. The upper end frequency response -3 dB point is set by the same equation, but with R2 and C2 substituted.

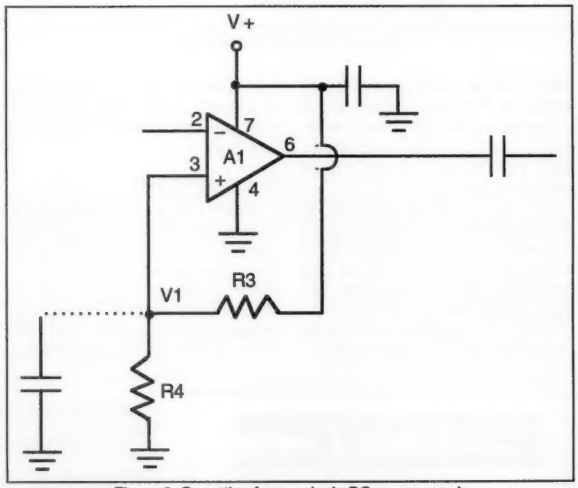

Figure 6. Operation from a single DC power supply.

Single DC Supply Operation

A lot of ham applications of op amps do not like the dual DC power supply requirement of these little ICs. There is a way to operate them from a single DC supply, even though it is suboptimum from several points of view (e.g. output voltage swing, DC component on the output signal, etc.). Figure 6 shows how single supply operation can be obtained in either form of op amp circuit. The VDC power supply terminal on the op amp is grounded, and the V+ terminal is connected to the positive DC power supply. A resistor voltage divider (R3 and R4) is used to bias the +IN input to some voltage V1. If R3 = R4, then V1 is one-half the DC supply voltage. This same voltage appears at the output of the op amp, so it's common to use capacitor coupling to the "outside world." In some cases, where it is desired to keep the +IN input grounded for AC signals, a bypass capacitor is shunted across R4. This capacitor should have a reactance that is less than R4/10 at the lowest frequency of operation . . . and the lower the better (I like R4/100 or less in my circuits).

Additional op amp circuits can be found in any of the many good books on the subject. Check either of my titles in the TAB/McGraw-Hill *Mastering . . .* series (one on amplifiers, the other on IC electronics). TAB can be reached toll-free at 1-800-233-1128 (in PA use 717-794-2191), or by mail at Blue Ridge Summit PA 17294.

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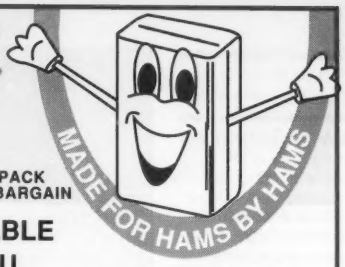

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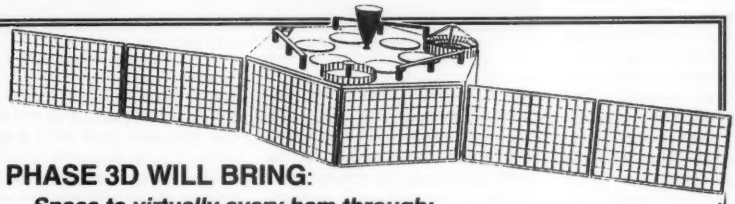

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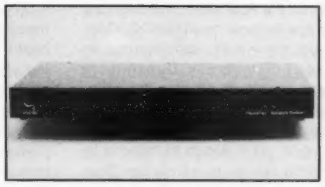

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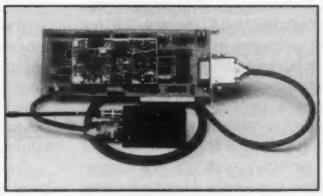

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CIRCLE 291 ON READER SERVICE CARD

HAMSATS

Amateur Radio Via Satellites

Andy MacAllister WA5ZIB
14714 Knightsway Drive
Houston TX 77083

Since the April 1993 "Hamsats" column and its focus on KITSAT-OSCAR-23, activity via this satellite has increased dramatically. During many passes over North America, the download request queue has been full, while many other stations stand by waiting to get in line to fill holes in incomplete files or to initiate new files. Pictures, voice mail, software, bulletins and messages from hams all over dominate the directory listings. With its higher-than-average low earth orbit of 1,300 km and high-speed 9600 bits-per-second (bps) frequency-shift keying (FSK) signaling rate, K-O-23 has become the most popular digital amateur satellite.

History

In 1989, the Satellite Technology Research Center (SaTReC) at the Korean Advanced Institute of Science and Technology (KAIST) began a joint effort with the UoSAT group at the University of Surrey in England to design and build a satellite for amateur radio communications and educational experiments. Sponsors in South Korea include the Ministry of Communications (MOC), the Ministry of Science and Technology (MOST), the Korean Science and Engineering Foundation (KOSEF) and Korea Telecom.

KITSAT-1, or KITSAT-OSCAR-23, was launched on August 10, 1992, from Kourou, French Guiana, as a secondary payload on the Ariane Structure for Auxiliary Payloads (ASAP). This was the first Korean satellite of any kind and provided an opportunity for graduate students at KAIST to learn firsthand about satellite design and construction.

The primary objectives of the program were to acquire satellite development technology, enlarge the number of engineers experienced with spacecraft engineering, motivate youth through space education, and widen the South Korean national interest on space science and satellites.

The experiments on board K-O-23 include the 9600 bps packet bulletin board system (BBS), the earth imaging experiment, a digital signal processing (DSP) experiment, and a cosmic ray experiment. All these systems have performed well.

The packet system has excellent transmit and receive characteristics. The power output is strong and correctly modulated and there have been few software crashes. The CCD (charge-coupled device) cameras have provided excellent black-and-white earth views. The DSP experiment has been heard "speaking" and the cosmic ray detector system has been providing data for study by those monitoring the telemetry. It is hoped that K-O-23 will continue to perform its radio and experiment functions for several years.

KITSAT-B

The SaTReC group is working on a new satellite scheduled for launch on August 31, 1993, once again from Kourou, French Guiana. Many of the experiments and activities planned for this hamsat are similar to K-O-23, but with improvements.

The transmitter and receivers will be similar to K-O-23 and will use the highly successful 9600 bps data transfer system with BBS operation. The main experiments will include a new camera system, an enhanced DSP experiment, an electron detector and an infra-red sensor device.

CEIS, or CCD Earth Imaging System, is designed to capture high and low resolution images of the earth using two separate cameras. The wide-angle system has a viewing angle of 76 degrees and a coverage of 1,022 by 990 km. The mean resolution is 2 km square and will provide black and white or color. A typical image file will require 250 Kb. The narrow-angle camera has a viewing angle of 12 degrees and sees an area 116 by 115 km. Resolution is 200-m square with black-and-white pictures of 350 Kb each. Both cameras can be commanded to take a picture at the same time. This results in the narrow-angle camera effectively zooming in on the center of the image captured by the wide-angle unit. Image processing and compression will be performed on the satellite to provide fast downloading of pictures.

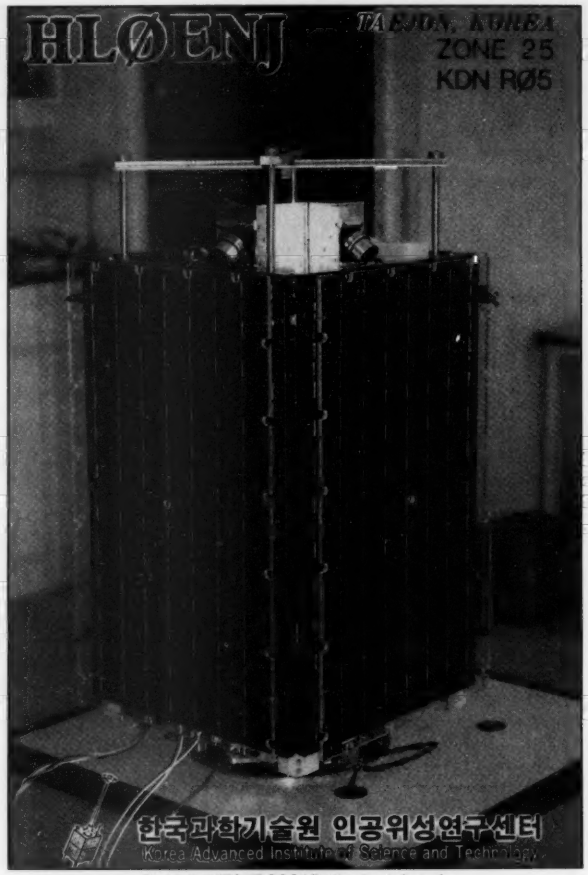

Photo A. KITSAT-OSCAR-23 prior to launch.

Photo B. Kyeongil Choi at the KAIST control center in Korea.

The DSPE, or Digital Signal Processing Experiment, will carry two units. The DSPE 30 is the primary system, with a TMS320C30 processor. The back-up unit employs a TMS320C25 chip and can be used in conjunction with the primary unit through a dedicated high-speed link when extra computational power is required. The system is similar to that on K-O-23. An enhancement over the previous system is the possibility of data transfer experiments at speeds greater than the 9600 bps hardware modem.

The LEED, or Low Energy Electron Detector, is designed to measure the electron flux in space and analyze the energy spectrum of the electrons in the auroral region. The system consists of four main components, including an electrostatic analyzer, spiraltron electron multiplier, high-voltage supply, and control unit. LEED can detect electrons with up to 6670 electron volts (eV) in 16 steps, with a resolution of 20 percent. The signals from the detector are fed to an analog-to-digital converter and then through control logic to the satellite's data handling system.

IREX, or Infra-Red Sensor Test Experiment, incorporates special sensors manufactured and calibrated at KAIST. IREX is an instrument to monitor the changes in the current and voltage characteristics of an infra-red sensor in a space environment. The sensor will be placed in a thermally-insulated housing with a window that looks out the top of the spacecraft. The experiment's electronics will monitor both the temperature change of the housing (since the detectors must operate at very low temperatures) and the degradation of the sensor over time.

KITSAT-B will become KITSAT-2 after launch. At that time it will also receive an OSCAR number. Although August is only a few months away, there are other satellites that may be in orbit first, including ARSENE from France, RS-15 from Russia, and UNAMSAT from Mexico. It's getting crowded up there. Amateur satellite activity has never been better.

Number 15 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
6 Jenny Lane
Baltimore MD 21208

It's an interesting time warp we write columns in. As I write these words, the Blizzard of '93 has just finished ravaging the East Coast. This "storm of the century" disrupted many plans, including a family affair we had been planning for several years. Our event has been rescheduled for June, just as this column will be published. Strange but true? You be the judge!

Anyway, that aside, here is a little note from Tom Vicinanza WA2UCH of Orlando, Florida, sent over the CompuServe network. Tom states that he read, with interest, my February 1993 column on getting an old Model 28 Teletype machine back on line. He has a Model 28-KSR about which he has some questions. Tom has a loop supply, made for the US Navy, which delivers 20 mA at 130 VDC. This loop supply appears to be an interface, and is labeled a "TeleTerminal." At any rate, his problems are where to put the current and where to connect the signal line. The machine has a polar relay, so the wiring will be different from that published in the February column. He believes that if the current is applied to terminal C5 (Black +) and C15 (Red -) that should be correct, but he doesn't see where to put the incoming signal from a decoder. Still C1 and C2? He asks how he can get his machine to run local, postulating that he could provide a closed loop to create the "sitting idle" effect, then connect the loop to the outputs of the TeleTerminal (or similar device) to print data.

Well, Tom, without knowing the circuit diagram of that "TeleTerminal," it is hard to say. Further, the circuit published in the February "RTTY Loop" was for a Model 28-RO, that is, Receive Only, as opposed to your Model 28-KSR, a Keyboard Send/Receive machine. Nonetheless, we can draw some conclusions. First of all, your polar relay needs a bias supply to keep the relay closed. This may well be provided by the TeleTerminal. The loop is interrupted by the signal, switching it on and off in step with the RTTY pulses. The interface, commonly called a "demodulator" or "terminal unit," normally takes care of this. Some terminal units provide an integral loop supply, which supplies the necessary loop current. Others terminate with an electronic switch, which serves to impress the RTTY signal onto an external loop. Whatever, you must determine the proper terminals to make the machine idle, then feed the loop signal into those terminals. Good luck, and I look forward to hearing from you with your results.

TUWIN Program

Another CompuServer is David Ventura KEØNA of Burnsville, Minnesota. He details purchasing an AEA CP-1 awhile ago, and building an RS232 interface for it using Radio Shack 1488 and 1489 chips. Built on a small board with jumpers to two wire-wrap sockets, the board plugs into the two sockets on the CP-1 board that use the old-style RS232 chips. He has been on RTTY for a few weeks and enjoys it very much.

Dave tells us about a program called TUWIN. It works quite well and he is able to fill the buffer as the other station sends, which keeps the QSO going quite nicely. He notes that the mode is just what he expected it to be: good old-fashioned rag-chews, no talking to BBS computers, and real people. Well, Dave, I hope you will send along a schematic of the interface you put together, and I will pass it along to the multitudes. But for the time being, I took a look at that TUWIN program you mentioned, and it is an interesting little program.

Written by Wayne E. Wright W5XD, it is designed as an accessory to the WriteLog Windows logging program to allow Windows-based logging and RTTY for contesting, as well as general operations. TUWIN works with old-style RTTY terminal units, like the HD-3030, MFJ-1229, or HAL ST-6, that do not do internal Baudot to ASCII conversion. It thus should not be used with multimode controllers like the PK-232 or KAM. With a split screen display, text to be transmitted is entered into the lower window, received text is displayed in the upper window.

"Overall, this is a neat, if bare-bones, approach to using an older terminal unit on RTTY..."

The program uses the DTR and RTS lines on the serial port to indicate "transmit," with the lines being keyed about 500 mSec before the first character is sent, and continuing until about 500 mSec after the last.

Overall, this is a neat, if bare-bones, approach to using an older terminal unit on RTTY, with a spiffy Windows display. TUWIN is available on CompuServe, in the HamNet SIG, or can be obtained from me for the customary $2 in US funds, 5" or 3.5" disk, and a STAMPED self-addressed disk mailer. Be sure to tell me that you want a copy of TUWIN, as mentioned in the June 1993 column.

The parent program, WriteLog, is available from Austin Code Works, 11100 Leafwood Lane, Austin, Texas 78750. Just be sure to tell them you read about it in *73 Magazine*'s "RTTY Loop," ya' hear?

Besides TUWIN, I continue to have several disks of RTTY and PC type programs available for a song. Collections #1 and #2 are RTTY and amateur radio programs; collection #3 is a bunch of archiving and utility programs for both DOS and Windows. Each collection will fit on a 1.44 Mb, 3.5" disk. One or two programs may be lost trying to cram them onto a 1.2 Mb 5" disk, and you will need to send a whole bunch of low density disks if that is your requirement. Anyway, for any or all of the collection, send me sufficient media, a return mailer with sufficient postage affixed, and $2 in US funds for each disk to be filled, to the above address. I am trying to turn these around within a few days so, if you have sent me a disk or disks and haven't heard in a reasonable period of time, drop me a note or E-mail message to make sure I received the original package.

See, the folks this month communicated with me via CompuServe, using my ppn, 75036,2501. Others have used America On-line, via MarcWA3AJR, and Delphi, also via MarcWA3AJR. You can do it too! I'll even register you for an America On-line sign-up kit, if you supply me with your name, address, phone number, and computer data. Sure, the U.S. Postal Service is fine, too, it's just so archaic! 73

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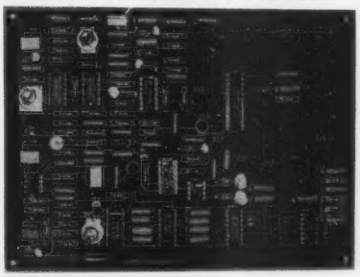
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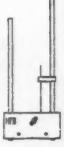
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Number 16 on your Feedback card

HOMING IN

Radio Direction Finding

Joe Moell P.E. KØOV
P.O. Box 2508
Fullerton CA 92633

Medal-Winning and Record-Breaking T-Hunts

Wichita, St. Louis, Toronto, Salem (Oregon and North Carolina), and Montreal have something in common. They are all cities with new and growing interest and enthusiasm for amateur radio direction finding (RDF) contests. In these hidden transmitter hunts (often called foxhunts or T-hunts), hams use special receiving equipment to find stations placed in unusual spots by other hams.

I learned about this new-found interest via letters and electronic mail from hams in each of these cities, plus others, in recent months. Many of them read about foxhunting for the first time in *73 Amateur Radio Today.*

Pack Your Toothbrush and HT

The 1993 Friendship Radiosport Games (FRG-93) are almost here. Here is your opportunity to take part in a world-class international on-foot foxhunt at a beautiful venue in Victoria, British Columbia. Kevin Kelly N6QAB/9K2FX, winner of the 1991 Friendship Games foxhunt, is expected to defend his medal, coming to the Games from his work assignment in Kuwait.

Foxhunters from Portland, Oregon (site of FRG-91), will be there, along with teams from California and Washington. Fifteen hams from Khabarovsk, Russia (site of FRG-89), will arrive in San Francisco on June 19 and proceed to Victoria for the contest and two weeks of international hospitality. Also expected are hams from Niigata and Morioka, Japan.

The FRG-93 foxhunt is expected to follow international standards, which call for five "foxes," transmitting in sequence for one minute each on 2 meters. Total course length will be about two miles. RDF equipment is being provided by the sponsors for your use, so you can travel light.

In addition to the foxhunt, there will be optional CW sending/receiving contests, a special events station (callsign XO7G), and a hamfest. At the hamfest you will find a swap meet, commercial displays, and a portable IPARN 2 meter satellite link across Canada.

Most events, including the foxhunt and CW contest, are scheduled for Saturday, June 26, at the spacious campus of Camosun College. An evening awards banquet will follow the competitions.

In recent conversations, I discovered that some hams think the Friendship Games are restricted to national champion foxhunters. Not so! Anyone who enjoys radiosporting is welcome. It's all for fun, in the spirit of international friendship and ham camaraderie.

For more information and to reserve your spot at FRG-93, write to FARS-Victoria, c/o Camosun College, Box 128, 3100 Foul Bay Road, Victoria, BC, Canada V8P 5J2. The information phone at the college is (604) 370-4420. Packet messages may be addressed to VE7KPV@VE7VBB.#ISLAND.BC.CAN.NA.

Be sure to indicate if you desire housing information. To find out more about what it's like to take part in international radiosporting, read "Homing In" for September 1991 and "Showdown in Portland" in the November 1991 issue of *73 Amateur Radio Today.*

A New Record for the Granddaddy Hunt

The Southern California All Day Mobile T-Hunt has taken place at least four times a year for as long as anyone can remember. There are only a few rules. The hider's 2 meter FM simplex signal must be copyable at the starting point. The T must be within the continental USA (no offshore islands, maritime mobiles, or trips across the Mexican border.) Lowest odometer mileage determines the winner; time doesn't matter in scoring. Nowadays, hiders and hunters are a bit disappointed if the hunt doesn't last at least 24 hours.

Just like other ham DXers, some hiders try to see how far away they can be. N6MI and WA6FAT set a record when they led the hunters to 8,351-foot Shuteye Peak near Yosemite National Park, 252 miles away from the starting point southwest of Los Angeles. For the February 27 All Day Hunt, Jim Forsyth AF6O and Eric Nansen N6YKE decided to immortalize themselves by increasing this record by 36 percent.

Jim told me that it was a lucky QSO that alerted him to the possibility of a record-breaking hunt. "The month before, a weekend hunt coincided with the January VHF contest. We ended up on Table Mountain looking for the hidden T, which wasn't there. While there, we decided to work a bit of the contest on 2 meters. We worked a guy who was putting in a strong signal from Utah. We got him to tell us where he was and how much power he was running."

"He told us that he regularly

Photo A. Kevin Kelly N6QAB/9K2FX looks over a new Japanese RDF set brought by Yoshiko Yamagami JQ1LCW to the 1991 Friendship Radiosport Games.

Photo B. Eric Nansen N6YKE and Jim Forsyth AF6O set a record by hiding 344 miles away on the Southern California All Day T-hunt.

Figure 1. The shortest route to the four T's in the February 27 record-setting hunt lay mostly along Interstate 15, with lots of ups and downs. An accurate bearing at the starting point was crucial for success.

worked people in Los Angeles and Orange Counties from that spot," Eric added. "Jim told everybody that we had found our spot for the February 27 hunt on this outing, which led them to believe we would be near Table Mountain, only 59 miles from the starting point."

The record-setting spot is called Utah Hill. It's along a stretch of old US Highway 91 from Littlefield, Arizona, to St. George, Utah, passing by Jarvis Peak. "It looks right down on the Grand Basin," according to N6YKE. "Except for a little ridge in the valley, we had 2,500 feet of elevation over everything between us and Las Vegas and beyond."

Would they be able to get a reliable signal across the 344 miles between this 4,724-foot mountain pass and the starting point? Jim obtained a 600 watt amplifier, a pair of car batteries to provide 28 volt power, float chargers and a generator.

On the day before the hunt, they went to the site to test with WB6ADC at the Rancho Palos Verdes starting point and N6XTJ on a hilltop in Orange County, keeping in touch on 40 meter mobile SSB. They transmitted 600 watts into a 15-element KLM Boomer yagi for an hour and a half with no success. Then they moved their setup down the hill about 150 feet. Immediately, both WB6ADC and N6XTJ heard them clearly on 2 meters with their T-hunting quads.

A successful test doesn't necessarily mean a successful hunt, however. Over this distance, 2 meter propagation varies with time of day and weather, and the weather was changing. "On hunt day, we encountered snow at 3,500 feet on the way to the site," said Jim. "It turned out to be no problem driving there. There were three to four inches of snow, but it was melting fast. Propagation peaked before start time, but the hunters heard us OK."

Now the hunt was on. Transmissions continued at 600 watts for two hours. Then Jim and Eric shut off the generator and dropped power to 15 watts. Hunting teams that were taking the correct route would be crossing 4,250-foot Cajon Pass summit by that time, and could still hear the signal.

One Is Not Enough

At starting time, only the Utah Hill T was on the air. But participants in Southern California All Day Hunts are alert for the possibility of multiple foxes. Sure enough, T #2 appeared two hours later, long before any teams got close.

"We hid it Thursday morning on our way out and set the timer to come on at noon Saturday," said N6YKE. "It was on Kelbaker Road, 0.4 miles south of the freeway offramp at Baker, California."

The third T was on Highway 169, which goes south from I-15 to Lake Mead at Overton, Nevada. "It was hidden on the northeast side of a hill with a beam pointing at Mormon Peak, a 7,411-foot mountain on the north side of I-15," said AF6O. "As you headed northeast on I-15, you couldn't copy the direct signal. All you heard was the reflection from Mormon Peak. Quite a few hunters got fooled by that."

The fourth T was near the I-15 Virgin River Gorge rest area in Arizona, nine miles beyond the Highway 91 exit to Utah Hill. "You had to get off at the rest stop and take a little dirt road on the opposite side of the interstate," said Eric. "People were `sniffing' at the rest stop because it was pointing at a cliff there. One team took several hours before they found it."

Once they got T #4 in place, Eric and Jim drove down I-15 toward Las Vegas, listening to the chatter on the hunt frequency and on the 40 meter SSB coordination frequency. They met up with hunter J. Scott Bovitz N6MI around dark and all three decided to go to a casino for dinner.

"Sure," Scott confirmed. "As long as we were in Vegas, we might as well get three-dollar steaks."

"Then Scott decided to spend a few minutes on the roulette wheel," Jim said. "So he bought a few chips, won about five dollars, cashed in, and continued on the hunt."

"Scott said he thought T #1 was about 40 miles further up the road at one of the microwave sites," Eric continued. "So he wasn't in any big hurry. We also found out that he didn't have good maps of the area. We were following him from Vegas toward Utah and he stopped at a mini-mart. Jim realized why, so he jumped out, ran into the store and bought up all the Utah maps before Scott could get one."

As it turned out, N6MI found all T's in lowest mileage order (2-3-4-1), despite his lack of maps. He won the hunt with 460 odometer miles from starting point to T #1. Scott arrived at Utah Hill after midnight in a snowstorm. "It was just perseverance," he explained. "But it was a whiteout condition at the end. You could see better with headlights off than on."

Eventually, five of the six starting teams found the Utah Hill station. Four teams found all four T's, although some had poor mileage because they found them in the wrong order. "All T's were just off the pavement," said N6YKE. "We didn't make them too difficult, because we didn't want to be be out forever."

Four transmitters in four states on one hunt! And you East Coast dwellers, who can drive through five of your tiny states between breakfast and lunch, remember we're talking big states here. Can other hiders top this? You can be sure some are studying topographical and relief maps trying to find a way.

Start Small, Have Fun

Don't get the idea that every hunt in Southern California is a marathon event. In Orange County, four clubs have begun monthly mobile outings just for beginning RDFers. They take place on various repeaters on weekday evenings, usually right after a club net, when listenership is high.

The hider makes short, frequent transmissions on the repeater input, urging every listener to get in the car and participate. Boundaries are small, usually just the county or part of it. After awhile, the fox station helps hunters by announcing smaller boundaries or giving other clues.

The idea is to insure that everyone finds the T in a reasonable period of time. To keep newcomers coming back, they need an evening of fun, not an ordeal. With a few short hunt successes, perhaps they will try longer-range hunts.

Pick Up Your Pen

I'm happy to get your letters telling about foxhunt activities in your area. I'm also pleased to see that new RDF equipment is becoming available in circuit board, kit, and assembled form, from a variety of individuals and companies. Beginning next month, "Homing In" will review some of these new offerings.

If you know of a new piece of foxhunting equipment, want to tell about your experiences with home-brew or commercial gear, or want to pass along news of your local hunts, write to me at the address above. Send E-mail via CompuServe (75236,2165) or Internet (JoeMoell@cup.portal.com). 73

Number 17 on your Feedback card

UPDATES

Computer Control for the Ramsey FTR-146

Refer to the above article on page 60 of the March 1993 issue. Due to a typesetting error, five lines of the program shown on page 68 have a less than (<) symbol substituted for an asterisk. These lines should read:

```
450 IF A=0 THEN HLDFREQ=VAL(FREQ$)*1000: MODE$="S": GOTO 480
460 HLDFREQ=VAL(LEFT$(FREQ$,A-1)*1000
40380 FREQ=(FREQ*1000)-143000!: OFS5=0
40400 FREQ=(FREQ/10)*128
40450 FREQ2=FREQ-(FREQ1*256)
```

73

Number 18 on your Feedback card

ASK KABOOM

The Tech Answer Man

Michael J. Geier KB1UM
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Scope It Out

Quite awhile back, I wrote about oscilloscopes and how great they are. If you're inclined to repair or build anything, you will find no tool more useful than a scope. You can find them at very reasonable prices, both new and at hamfests. Oddly, most hams I've talked to seem afraid of scopes, simply because they've never used them before and don't really know how to operate them. Besides, there are just so darned many knobs and buttons! This time, let's explore scopes in more depth and take a look at what the various features controlled by those knobs can actually do for you.

The Basic Beast

Essentially, a scope is a graphing machine. Specifically, it produces a fleeting graph of voltage over some specified period of time. The faster a signal it can graph, the "faster" the scope is said to be, and the more expensive it is. For HF circuits, a 50 MHz scope, which is pretty common these days, should be fast enough. For VHF and UHF, though, the cost of a capable scope will probably put it out of reach. Sometimes you can get lucky; I bought a 150 MHz scope at a hamfest for $200. Sure, it was a risk, but the temptation was just too great to ignore. That scope lets me work on 2 meter rigs with great success because I can actually view the signals at 148 MHz! Some exotic lab scopes go to beyond 1 GHz, but you won't find one at a hamfest.

It's incredibly useful to be able to see how a signal changes over time, and it's not particularly hard to do, but that may seem hard to believe when you look at the front panel of your scope. It seems like there's enough there to pilot the space shuttle! So why are there so many confusing knobs and buttons on today's scopes?

One Size Doesn't Fit All

Scopes seem complicated because their screens are of finite size! And a pretty small size to boot. Let's face it, you really can't see that much at once. Most of the controls are there to let you scale the signal and scope parameters in such a manner that you can see what you want to see.

With the exception of a few new, expensive LCD pocket models, oscilloscopes use cathode ray tubes (CRTs) similar to those in TV sets. So, naturally, there are some controls dedicated to adjusting the electron beam itself. You'll find brightness and focus, and those are self-explanatory. You might also find an astigmatism control. That one keeps the shape of the electron beam from getting stretched out as it sweeps up and down. Depending upon the signal you're looking at, you may have to adjust any or all three of these things to get the clearest view. On better scopes, though, the focus and astigmatism tend to stay put over wide signal variations, and some don't even need to have astigmatism controls.

There are many ways to use a scope, but by far the usual way is to graph voltage over time. (Other ways include frequency vs. time, two signals vs. each other, and more.) Because we're working with the good ol' Cartesian (X/Y) coordinate system here, our two basic parameters are horizontal and vertical. You move the CRT's electron beam up and down (X) in step with the incoming signal you want to view, and you sweep the beam from left to right (Y) at some predetermined rate. Let's look at the X (vertical) issues first.

Squeeze Me, Please

The object here is to squeeze the signal down so that all of it remains on the screen. Well, usually. Sometimes you want to see some small part of it which is near the middle or the top or bottom and you don't care if other parts are lost over the screen's edges. Either way, the VERTICAL AMPLITUDE control lets you make it as big or small as you want. Most scopes use a 1-2-5 arrangement for maximum convenience. What I mean by that is that the steps on the control are arranged like this: 100 mV, 200 mV, 500 mV, 1V, 2V, 5V, and so on. I can't explain why that arrangement is so nice to use, but if you try it, you'll see that it is; it just gives you steps that seem to fall where you want them. By the way, those numbers refer to the amount of voltage it will take to move the beam up or down one box on the graticule, which is the set of boxes drawn on the CRT's faceplate.

Concentric with the vertical amplitude control is a variable knob which lets you set values in between those you can select with the stepped knob. When turned all the way up, the variable knob is said to be in the calibrated position, which means that the number you select on the stepped knob will be correct. So why would you possibly want to *uncalibrate* your oscilloscope? Usually, you only do that when you need to take a comparative measurement—say, for instance, that you want to see if one signal is just a little bigger or smaller than another. The reference signal is 3.47 volts peak-to-peak, so neither of its peaks hits any of the graticule markings. Now you look at the other signal and, gee, it kinda looks the same, but it could be a little different. If you go back to the reference signal and use the variable control to reduce it until its peaks line up with some of the graticule markings, it becomes much easier to tell how another signal, or the same signal at a later time, compares. Just be sure to reset the variable control to its calibrated position when you're through. I can't tell you how easy it is to forget to do that and spend the next two hours going around in circles because you're working with an incorrectly calibrated instrument!

Going Up?

Somewhere near the amplitude control (also sometimes called the "attenuator") you'll find a position control. All this does is let you move the entire waveform up or down in order to line it up with the graticule. It does not make the signal bigger or smaller; it just shifts its position. You may also find an "invert" button. That lets you flip the waveform upside down. It can be handy if it helps you to visualize what is going on in the signal, and it is especially useful with multiple-channel scopes (which we'll get to later) because it lets you subtract signals from each other in order to see tiny differences between them.

AC/DC

Not the rock band. This button lets you select the type of coupling between the probe and the scope. If you select DC, any voltage level, even a non-changing one, will move the trace on the CRT. That's handy for checking DC voltages and offsets. If you pick AC, though, a capacitor is placed in series with the probe, and the scope will only display *changes* in the signal. Ironically, that's most useful on DC signals! You use it when you want to see, for instance, how much ripple there is on a power supply's output. If you're testing a 12 volt supply, you can't see 100 mV of ripple because the trace would be way off the screen at that scale. But, with AC coupling, the 12 volts are blocked, and you can set the amplitude control as sensitive as you need it. Then, 100 mV of ripple can fill the entire screen!

A Probing Topic

No discussion of an oscilloscope's vertical stages would be complete without talking about the probe you use to connect the scope to the circuit you're examining. It may seem obvious that the probe is nothing more than a piece of wire, but that often isn't the case. Most probes are either 10:1 or switchable 1:1/10:1 types. The ratio refers to the amount the probe will attenuate the signal before it enters the scope's input stages.

Why the heck would you want to do that? Two reasons: First, the signal may be so big that, even with the amplitude knob set to its highest range, the waveform won't fit on the screen. That happens, but not all that often with today's solid-state gear, which uses fairly small signals in most stages. Second, reducing the signal right at the probe raises the apparent input impedance of the scope by the same factor. So, if your scope has a 1 megohm input impedance and you use a 10:1 probe, your circuit sees a 10 megohm input impedance instead of the 1 meg it would see with a direct connection. That is very handy because it avoids loading down the circuit and the false readings that can result. In practice, it usually pays to use the 10:1 setting and make up for the gain loss by increasing the scope's sensitivity with the amplitude control. Of course, if the signal is extremely small, you may not be able to do that, and you'll have to switch to the 1:1 setting on the probe.

Passive Resistance

The probe's attenuation is provided by a simple two-resistor network. There's a resistor in series with the tip and another to ground at the first one's other end. The scope connects to where the two resistors meet.

If you look at a 10:1 probe, you'll notice a small screwdriver adjustment. This lets you set the probe's capacitance to match that of the scope's input stage. If it's set wrong, signal peaks will be either exaggerated or squashed down. To make sure it's set right, connect the probe to the scope's CALIBRATE pin. That pin provides a square wave, usually at about 1 or 2 kHz. All you do is set the probe to 10:1 (if it's switchable), set the scope's coupling switch to DC, and turn the probe's adjustment until the tops and bottoms of the square wave are as flat as you can make them. If your scope has no CALIBRATE pin or its oscillator is broken (as it is on one of mine), you can use any rea-

sonably clean 1 kHz square wave. If you change the probe to another channel or use another probe, you'll have to recalibrate it, because no two input channels are exactly the same, not even on the same scope! It always pays to check.

That should about cover all of the vertical controls on most scopes, with the exception of a few found on multiple-channel units. Next time, we'll get into those and the really fun part: time. Now, let's look at a letter.

Dear Kaboom,

What's the difference between a linear amp for FM/CW and one for SSB? Can I use a CW-type amp on 50-MHz SSB?

Signed,
Wanna Talk

Dear Wanna,

We hams have a habit of calling any big RF amplifier a "linear" amp. Unfortunately, not all amplifiers are truly linear. Those made for FM or CW don't have to be because the exact waveform, and its precise amplitude changes, don't carry intelligence. So, you can get away with lots of distortion and then clean it all up with a filter before you send it to the antenna. That's precisely the technique used in walkies and CW transmitters, and not just because it's cheaper. It's also considerably more power-efficient. For AM and SSB, though, you need true linearity. That means that the output power of the amp must go up and down exactly in step with the input signal's amplitude changes. After all, those changes represent the modulation you want to transmit in the first place! The basic difference between the two types lies in how the power element, be it tube or transistor, is biased. A truly linear amplifier has enough bias voltage on the element that both the positive and negative peaks of the incoming signal are accurately amplified and not clipped off. So, if your amplifier is truly a *linear* amplifier, it should work fine on SSB. If you're not sure, try running it into a dummy load and listening with another rig. If the audio is horribly distorted, the amp will need some modification to be useful on SSB. By the way, you should never run an SSB amp anywhere near full power on FM, not because it won't work, but because the constant full power demanded by this mode probably will overheat and destroy the amp!

See you all next time.

RANDOM OUTPUT

Continued from page 88

round attendance figure. Let's be generous and assume that two-thirds of those tickets are paid at the pre-registration price of $11 and only one-third are bought at the door for $14. That's another $360,000. There were 48 pages of advertising in last year's program book, at a round figure price of $780 per page, so $37,440 is the take on that.

Adding up the figures, we come to a very conservative income estimate of $898,515. Since most of the staff working the hamfest are volunteers, the expenses are a lot less than they would be for another industry's trade show. Renting the Hara Arena, security, advertising, printing of tickets and programs and paying for some of the speakers' travel and lodging are the only major expenses.

As long as everything is on the up-and-up, I'm the last person on earth who would begrudge any person or organization from making as big a profit as they can (I'm a capitalist to the very core). I honestly don't care what happens to the profits, and frankly it's none of my business. Since none of that money seems to be spent on improving the conditions and services of the Hamvention, I simply wonder where it's all going.

What really put the icing on the cake for me was my dealings with the guy who ran the exhibitors' booths last year. After *73* had spent something like 20 years in the same spot, he wrote to me and told me that because our check had not been received in time, we would not be able to retain the same booth space. In fact, after calling this gentleman, he informed me that he had already given the booth to another exhibitor, and he had already told the other exhibitor the good news. All the time, this gentleman assured me that the fact that our two booths, on the end of a row, has restricted them from forming a two- or four-booth "end cap" had nothing to do with *73* losing the space. Of course, you can probably guess what type of booth arrangement the new tenants were planning. Though it took many phone calls and some smooth talk, *73* finally got the booth, but it left a sour taste in my mouth. I'd rather not do business with a company that treats its customers so shabbily. I wonder if Kenwood, ICOM or Yaesu would have their booths taken away without so much as a courtesy phone call.

The unfortunate thing about all of this is that *this year's* booth chairman seems like a very professional and pleasant chap. In fact, I'm sure that all of the volunteers and club members who work the Hamvention are nice folks. If it weren't for reason #1, I probably would have given Dayton one more try. Nontheless, after talking it over with Wayne, we decided that the liabilities of exhibiting at Dayton far outweighed the benefits. We'll rethink our decision from year to year, but I'm happy with what we're doing.

After all, would you be willing to pay a higher cover price or subscription rate, just so *73* could have a booth at Dayton? I thought not.

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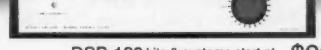

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Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the January issue, we should receive it by October 31. Provide a clear, concise summary of the essential details about your Special Event. Check ***Special Events File Area #11*** *on our* ***BBS (603-924-9343)****. for listings that were too late to get into publication.*

JUNE 5

NORWICH, CT The annual Ham Radio Auction sponsored by the Radio Society of Norwich, will be held from 10 AM until sold out, at the Waterford Senior Citizen Center, Waterford Municipal Complex. Bring your equipment to be auctioned. Talk-in on 146.07/.67 rptr. Contact *KA1BB at (203) 739-8016.*

SOUTH BURLINGTON, VT Come to the South Burlington Middle School on Dorset St., to enjoy the Northern Vermont Mid-Summer Hamfest. Time: 8 AM-3 PM. VE Exams at 2 PM. Talk-in on 145.47 (-600) or 146.85 (+/-600). Contact *Joe Tymecki N1DMP, (802) 893-6458* or *Mitch Stern WB2JSJ, (802) 879-6589.*

JUNE 6

CHELSEA, MI The Chelsea Swap & Shop, sponsored by the Chelsea ARC Inc., starts at 8 AM at the Chelsea Fairgrounds. Talk-in on 146.980-. Contact *Gary R. Widmayer N8AYY, P.O. Box 325, Manchester MI 48158. Tel. (313) 428-9398.*

MANASSAS, VA The Ole Virginia Hams ARC will sponsor the Manassas Hamfest/Computer Show at the Prince William County Fairgrounds. Open to the public at 8 AM. Talk-in on the Manassas rptr., 146.37/.97 and 223.06/224.66. Commercial vendors contact *Woody KD4DEG at (703) 368-5180.* For info, call *Mary Lou KB4EFP, (703) 369-2877.*

NEWINGTON, CT The annual Amateur Radio and Computer Flea Market, sponsored by the Newington AR League, will be held from 9 AM-2 PM at Newington High School. Guided tours of ARRL headquarters and W1AW. VE Exams (no walk-ins); SASE to *Susan Fredrickson WM1B, P.O. Box 165, Pleasant Valley CT 06063.* For info and Flea Market reservations, contact *Jim Carney KA1TAF, c/o NARL, 34 Meadow St., Newington CT 06111; Tel. (203) 673-0884;* (SASE for confirmation).

PRINCETON, IL The Starved Rock Radio Club Hamfest will be held at the Bureau County Fairgrounds, starting at 6 AM. Talk-in on 146.355/.955. Contact *Mark Tondi N9OVD, RR1 Box 34, Peru IL 61354. Tel. (815) 446-4342;* or *Nils Barto, Jr. N9PLJ, 2238 Schuyler Dr., Peru IL 61354. Tel. (815) 224-1299.*

JUNE 12

BANGOR, ME A Hamfest, sponsored by the Pine State ARC, will be held at the Hermon Elementary School from 8 AM-1 PM. Flea Market. VE Exams. Contact *Roger W. Dole KA1TKS, RR #2 Box 730, Bangor ME 04401. Tel. (207) 848-3846.*

LOVELAND, CO The Northern Colorado ARC will present "Superfest XV" at the Larmer County Fairgrounds, 700 S. Railroad. Open to the public at 8 AM. ARRL VEC Exams (call *Rick Hubbard WA0DDC, (303) 353-3577*). Talk-in on 144.515/145.115 and 146.25/.85. For table reservations, contact *Orlin Jenkins K0OJ, 2101 5th St., Greeley CO 80631; Tel. (303) 353-7094.* For details, contact *John Schmidt NK0R, 1001 King Dr., Loveland CO 80537; (303) 663-7581.*

MARMORA, ONT., CANADA Eastern Ontario Hamfest, sponsored by the Marmora ARC, will be held at 9 AM at the Marmora Curling Club. Talk-in on VE3TZW 145.41/144.81 rptr. Info and table contact: *Paul VE3UUM, (613) 472-3449.*

WINSTON-SALEM, NC The Winston-Salem Hamfest/Computer Fair will be held at Lawrence Joel Veterans' Coliseum Annex, 9 AM-5 PM. Talk-in on 146.04/.64. Send SASE to *B.J. Honeycutt, Winston-Salem Hamfest, P.O. Box 11361, Winston-Salem NC 27116. Tel. (919) 723-7388 (24 hrs).*

JUNE 13

DARIEN, NY The Lancaster New York Hamfest, sponsored by the Lancaster ARC, will be held at Darien Center Fire Co., on RT 77 at RT 20. Talk-in on 147.135 +.600, 146.550 simplex, and 443.850 +5. Contact *Nick WA2CJJ, 5645 Genesee St., Lancaster, NY 14086, (716) 681-6410;* or *Luke N2GDU, 1105 Ransom Rd., Lancaster NY 14086, (716) 683-8880.*

ERLANGER, KY The Northern Kentucky ARC will sponsor "Ham-O-Rama 93" at Erlanger Kentucky Lions Park. Doors open at 8 AM. Talk-in on 147.255+ or 147.375+ rptrs. For info, registration, contact *KC4FET c/o NKARC, P.O. Box 1062, Covington KY 41012. Tel. (606) 341-1213.*

GRANITE CITY, IL The Egyptian RC will conduct its annual EGYPTIANFEST at the club grounds on Chouteau Place

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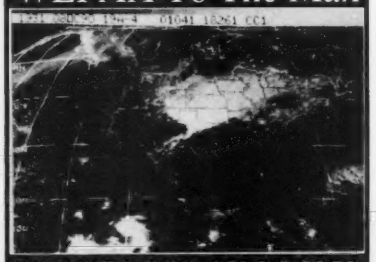
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Rd., from 6 AM-1 PM. VE Exams will be conducted at Sanford Brown Business College, 3237 W. Chain of Rocks Rd. Please contact *Eric Koch NF0Q, (314) 946-0948* for pre-registration. Talk-in on the ERC-W9AIU 146.76 rptr. For info, tickets, contact *Larry Walton NZ0P, at (314) 524-3254; 524 Heather, St. Ann MO 63042*; or *Bill Dusenbery N9OQK, at (618) 345-7587; 1260 St. Louis Rd., Collinsville IL 62234.*

STEVENS POINT, WI The Central Wisconsin Radio Amateurs, Ltd., will hold its 16th annual SWAPFEST at the University Center on the University of Wisconsin-Stevens Point campus, from 8 AM-1:30 PM. ARRL VEC Testing. Contact *Art Wysocki N9BCA, CWRA Swapfest Chairman, 3356 April Ln., Stevens Point WI 54481. Tel. (715) 344-2984.*

STOW, OH The Goodyear ARC will hold its 26th annual Hamfest and Family Picnic at Wingfoot Lake Park near Akron OH. Flea Market from 8 AM-4 PM. For tickets and info, contact *William F. Dunn W8IFM, 4730 Nottingham Ln., Stow OH 44224. Tel. (216) 673-8502.*

WILLOW SPRINGS, IL Come join the fun at Santa Fe Park, 91st and Wolf Rd., where the Six Meter Club of Chicago, Inc. will hold its 36th annual Hamfest. Gates open at 6 AM. Talk-in K9ONA 146.52, or K9ONA 146.37/.97 rptr. Order advance tickets from *Mike Corbett K9ENZ, 606 South Fenton Ave., Romeoville IL 60441*, or any club member. Dealers: For pavillion reservations, contact *Joseph Gutwein WA9RIJ, 7109 Blackburn Ave., Downers Grove IL 60516. Tel. (708) 963-4922.*

JUNE 19

CORTLAND, NY The Skyline ARC will hold their 11th annual Cortland Internat'l Hamfest at the Cortland County Fairgrounds from 7 AM-3 PM. VE Exams by reservation only. Talk-in on 147.780/.180. Dealers contact *S.A.R.C., P.O. Box 5241, Cortland NY 13045. Tel. (607) 756-6550 eves. or weekends.*

GRANDVIEW, MO The Dixie ATV Soc. will sponsor the Dixie ATV Hamfest from 8 AM-3 PM at the Grandview Middle School, 12650 Manchester. Talk-in on 144.34 MHz simplex. VE Exams. Contact *Steve Carroll WV0J, 200 Monroe, Belton MO 64012. Tel. (816) 322-4429.*

MIDLAND, MI The 19th annual Midland Hamfest, sponsored by the Midland ARC, will be held at the Midland Community Center, George St. at Jefferson, from 8 AM-1 PM. VE Exams, walk-ins okay. Talk-in on Midland 147.00+. Contact *Bill N8LTR at (517) 832-3053* for info. Send reservation payments to *MARC Hamfest, P.O. Box 1049, Midland MI 48640.*

JUNE 19-20

BURBANK, ALBERTA, CANADA The Burbank Campground will be the site of the 22nd annual Picnic sponsored by the Central Alberta Radio League. Sat. June 19th: Golf Tournament at 0730 hrs; Barbecue Dinner at 1800 hrs.; Flea Market. Sun. June 20th: Pancake Breakfast at 0800-1000 hrs. Many other events. Contact *Blair Heinzlmeir VE6BJH, (403) 343-1655.* Talk-in on 147.150 +0.600 MHz, or 146.520 simplex.

JUNE 20

CAMBRIDGE, MA The MIT Radio Soc. and the Harvard Wireless Club will hold their TAILGATE Electronics/Computer/Amateur Radio FLEA MARKET at Albany and Main Sts., from 9 AM-2 PM. Talk-in on 146.52 and 449.725 - pl 2A - W1XM rptr. Call *(617) 253-3776* for details.

FREDERICK, MD The Frederick ARC will hold its annual Hamfest at the Walkersville Firemen's Carnival Grounds from 8 AM-4 PM. Talk-in on 147.06/+, 146.52, and 448.425/-. For info, write to *Frederick Hamfest, P.O. Box 1260, Frederick MD 21702.*

MONROE, MI The Monroe County Radio Communications Assn. will sponsor the Monroe Hamfest at the Monroe County Fair Grounds, M-50 at Rasinville Rd., from 8 AM-2:30 PM. VE Exams by pre-registration only. Contact *Fred E. Lux WD8ITZ, 5742 Parkside Dr., Monroe MI 48161. Tel. (313) 243-1053.*

SANTA MARIA, CA The Satellite ARC will hold its annual Santa Maria Swapfest at the Union Oil Picnic Grounds. Gates open at 9 AM. Dinner served at 1 PM. Talk-in on WB6IIY/R 146.34/.94. Call *Rick Laird KB5OO, (805) 937-8337*, or write to *Santa Maria Swapfest, P.O. Box 2067, Orcutt CA 93457.*

JUNE 24-27

VICTORIA, B.C., CANADA The Friendship ARS of Victoria will sponsor the 3rd Internat'l Friendship Radiosport Games and Hamfest. Talk-in on 146.84 rptr., or 147.42 simplex. Contacts: *Tel., (604) 370-4420; FAX, (604) 370-3750; Packet, VE7KPV @ VE7VBB.#ISLAND.BC.CAN.NOAM.*

JULY 3

LEHMAN, PA Come to the Luzerne County Fair Grounds, Route 118, to enjoy the 14th annual Wilkes-Barre/Murgas ARC Hamfest and Computerfest. Gates open at 5 AM. Talk-in on 53.61, 53.81, 146.52, 146.61, 449.825 PL82.5 Hz. For details, call *KA3A, (717) 824-5724 days; (717) 825-3940 eves.* For tables, contact *K3SAE - KB3GB, RD#1, Box 214, Pittston PA 18643. Tel. (717) 388-6863.*

JULY 4

HARRISBURG, PA A Hamfest, sponsored by the Harrisburg RAC, will be held from 8 AM-2 PM at the Bressler Picnic Grounds. Talk-in on 6.76/R or 52/52. Reservations contact: *Steve Gobat KA3PDQ, (717) 938-6943.*

SPECIAL EVENT STATIONS

JUNE 12

WALLINGFORD, CT Grand Lodge A.F. & A.M. of CT amateurs will operate WT1R 1300Z-2100Z at the Masonic Home and Hospital, to celebrate Grandmaster's Day. Operation will be in the lower General portion of the 80-10 meter bands. For QSL, send SASE to *Bruce Backer, Box 5028, New Haven CT 06525.*

JUNE 15-18

LONDON, ONT., CANADA The London ARC will operate CJ3-LON from a hot air ballon on one of the following evenings: June 15, 16, 17, or 18; and the morning of June 19th, to celebrate the 200th Birthday of London, Ontario. Frequencies: 146.52, 446.00 simplex, and FSTV 439.25 TX only. For commemorative QSL, send QSL and SASE to *Anthony Drawmer VE3-SQU, 55 Briscoe St West, London N6J-1M4 Ontario, Canada.*

JUNE 18-20 and 25-27

WASECA, MN June 1993 marks the 70th year that E.F. Johnson Co. has manufactured radio and electronic components. To celebrate this historic event, the Viking ARS will operate a SE Station using Edgar Johnson's original callsign, 9ALD. If it is unavailable, WA0CJU, the club call of the Viking ARS, will be used for the duration of the event. Operation will take place on all non-WARC bands from 160-10 meters using a mixture of AM, SSB, and CW. Send an 8 x 11 SASE for a QSL card and special certificate, or a letter size SASE for the QSL card. For more details, call the *24-hour-hot-line, (507) 835-6612.* Send requests to *E.F. Johnson Co., ATTN: 70th Anniversary Special Event Station, P.O. Box 1249, Waseca MN 56093.*

JUNE 19

SPIVEYS CORNER, NC Triangle East ARA will operate AC4QD 0300Z-1200Z, to celebrate the 25th annual Nat'l Hollerin' Contest. Frequencies: CW 7.135 and 21.405; Phone 28.335 and 14.260. To get a certificate, send QSL and SASE to *TEARA, 209 N. Third St., Smithfield NC 27577.*

YUMA, AZ The Yuma ARC will operate a Special Event Station in commem-oration of the 50th Anniversary of the US Army Yuma Proving Ground. Operations will be in the 15 and 20 meter General, and 10 meter Novice phone subbands, from 1500Z-2400Z. For a certificate, send QSL and a 9 x 12 SASE to *Operator CBA or YARC, P.O. Box 7077, Yuma AZ 85366.*

JUNE 19-20

ARCADE, NY The Pioneer Radio Operators Soc. (PROS) will operate W2CRY from the Curriers, NY Railway Station, to celebrate the one millionth passenger carried by the Arcade and Attica Steam Railroad. Operation will be in the General SSB/CW 10, 15, 20, 40, and 75 meter bands with 2 meter "railmobile" operation on 145.390 MHz rptr. SASE to *W2CRY, 9765 S. Protection Rd., Holland NY 14080*, for a special QSL.

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Ocean Challenge

In 1853, the 200-foot clipper *Northern Light* set the sailing record from San Francisco to Boston, 15,000 miles, in 76 days and six hours. Rich Wilson WA1BZE and Bill Biewenga aboard the 53-foot trimaran *Great American II* are trying to break that record.

In January of this year, the science coordinator of the Staten Island school district, where I teach, invited me to participate in Ocean Challenge with my ham radio classes. I was able to make contact with Lyon Osborn in the Boston home office. He was the telephone link with Bill and Rich once they set sail in January. He and I arranged for the initial ham radio contact to take place on March 26th.

A curriculum book was provided to us which included lessons about longitude and latitude, boat structures, weather, teamwork, geography, and communications. The children enjoyed the preparatory lessons on courage and perseverance. They were fascinated to learn that Rich has a severe case of asthma. He must take medication four times a day. This is the reason that the American Lung Association is one of the sponsors of Ocean Challenge.

We spoke in class about what kind of personality characteristics we expected to find when and if we got our chance to speak with Rich. I explained to the children that three years ago Rich was the skipper of the *Great American I*, when he attempted the same voyage. On Thanksgiving Day in 1990 the boat capsized and was lost when a 50-foot wave swept over it during stormy seas. He and his co-skipper were lucky enough to be rescued that night by a cargo ship heading towards New Zealand. This has prompted many people to ask him why he would want to take the risk again.

For days prior to the contact, the children in my 6th, 7th, and 8th grade radio classes wrote down questions that they would like to ask Rich. There was a lot of good, creative thinking going on. I chose the best questions, and made arrangements for those children to stay after school for the prearranged contact on 20 meters.

When we finally were able to establish a contact with WA1BZE/MM we were all quite excited. Each child lined up at the rig to ask his or her question. One of my youngsters, Jordan KB2PYS, asked about the kinds of birds that they had seen. At the time of the contact they were 45 degrees west of Cuba. Rich is an extremely verbal operator and he went into great detail about the albatrosses they had spotted in the South Seas. He described them as unique, graceful birds with wing

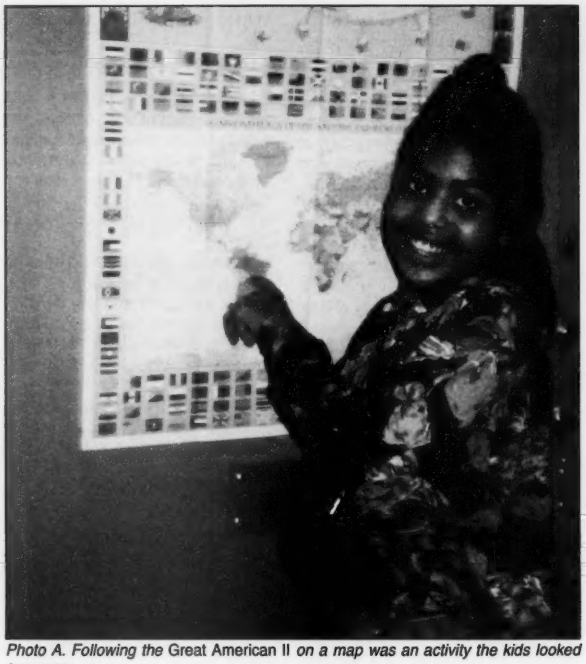

Photo A. Following the Great American II *on a map was an activity the kids looked forward to.*

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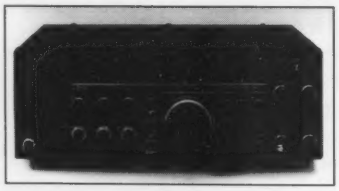

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spans up to seven feet. Rich also described the beautiful color of the sky and the sea and the prolific amount of flying fish they kept encountering.

One student asked about the most amusing thing that happened on the trip so far. Rich described how they had heard something tapping and scratching on the hull bottom, so he dove into the cold, dark sea where he discovered and removed a giant kelp. While in the water, he got hit right in the face by a flying fish.

Rich spoke at great length to my kids about the importance of pursuing a dream. In answer to the obvious question, "Why are you doing this again?" Rich said that once a person has a goal or a dream he must never give up trying to accomplish it, no matter what obstacles he has to overcome. In his own case, Rich received enormous support from his mother who constantly encouraged him in this endeavor. The fact that he had to provide for the circumstances of his physical disability made his story that much more inspiring.

Second and Third Contacts

We made contact again with the *Great American II* on March 29th and March 30th. We listened as Rich described to the children how wonderful it feels to be out at sea in the clean fresh air while he gazes at the beautiful expanse of water going into an azure-colored sky. He told us that his breathing problem was tremendously improved because of the clean fresh air. On the second and third contact he answered questions about the differences in construction between this boat and the *Great American I*. He told us about the division of labor between the two men and what it was like to be one half of a two-man crew on a voyage of this duration. He told the children that every team needs a leader (at sea, the skipper) and a chain of command. Bill and Rich decide sail changes and strategic weather routing constantly. When on watch, Bill sails the boat his way, with the proviso that major changes/decisions must fall in the skipper's lap.

One of the most interesting discussions in our contact with Rich took place when I asked him to compare and contrast what he was doing with the work of the astronauts on board a space shuttle. My kids are very much involved with NASA's SAREX (shuttle amateur radio experiment) program. He pointed out many similarities that provided me with material for many follow-up activities and lessons for the class. The children were the ones who commented on how the astronauts and Rich both had a pioneering spirit and were willing to take great risks to achieve their goals.

We couldn't make contact with them after the 30th because rough seas required that they both concentrate on moving the trimaran forward without their attention being diverted. Rich said that although they had computers set up with satellite communications system, he counted on ham radio for his most up-to-date weather information and found that the support of hams along the route was invaluable.

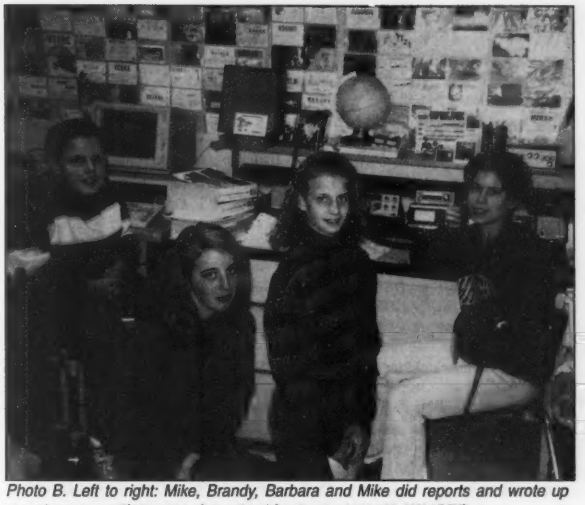

Photo B. Left to right: Mike, Brandy, Barbara and Mike did reports and wrote up questions to qualify to stay after school for the contact with WA1BZE.

As of this writing, they calculate at least another week before they dock in Boston. We'll all be watching with tremendous interest to see if they break the record. Rich has promised to make arrangements to visit our school and meet with the youngsters he spoke with on ham radio. What other kind of classroom can you think of that could offer this kind of incredible experience to young people? 73

[Editor's Note: As we went to press with this issue, Rich Wilson and Bill Biewenga made landfall in Boston on April 7th. Their total time of 69 days, 19 hours, 44 minutes is the new San Francisco-to-Boston record.]

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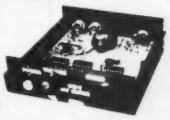

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Wrap-Up on the Controller Project

This month we'll wrap up some of the loose ends left dangling from our latest project.

There is a terminal block, available from Mouser Electronics (1-800-346-6873; stock number 506-8PCV-04), that fits the PC board and allows for easy connections between the array and the battery. Also, the trimmer used to set the state of charge is a Mouser number ME324-CP10H-470k. You can, of course, use other styles of trimmers, but they won't fit the board. The trimmer used to set the reference voltage is a 20-turn trimmer, also available from Mouser (stock number 594-64W102).

If you can't get the circuit to operate, the first thing to check is the reference voltage. No reference voltage or an incorrect reference voltage will produce a dead controller. By adjusting the trimmer, you should be able to vary the voltage around the set point of 4.4 volts. Check for +12 volts on the input of the 7812. Also, check for +12 volts on the input of the LM317Z. If you've got that, then the trouble may be with the LM317Z. Be sure you don't have it installed backwards. It's easy to do with the TO-92 case style.

It's also a good idea to check for VCC on each of the chips. Remember, on the LM324, VCC is on pin #4; and on the 4001 it's on pin #14. Also, while you're at it, probe the ground pin. Being at ground, the pin should be zero. If not, then you have a soldering error on that chip. You may also have a broken trace on the PC board.

Double-check for the proper reference voltage on all points requiring it. Now, check for the proper function of the state-of-charge voltage. Adjusting the 470k trimmer should vary the voltage on the output pin of the op amp. If not, then you have either a wiring error or a bad section of an op amp. If you have the chip in a socket, swap it out with another one and retest the circuit.

Check to see if you have the required +20 volts on the gate of the FET when the charging LED is on. If not, then you have either a bad 4001 or a problem in the voltage multiplier diodes. Use an oscilloscope and check the output of the oscillator. It should be a 2 volt peak square wave. Also, both of the control pins on the 4011 must be low when the charging LED is on. If not, then work back to the op amp switch. Swapping out an IC to find a bad op amp or gate is the best troubleshooting method for this section.

If everything seems fine but you still can't pass current, re-check the connections between the MBR1635 and the power MOSFET. Notice that the MBR1635 leads are backwards compared to most diodes. Some 1635s have a diode symbol to show what lead is what. See Figure 1 for a clearer view on how to connect the MBR1635 and the power FET.

You can expand the current capacity of the controller by increasing the current capacity of the blocking diode and the power MOSFET. An SD51 will handle up to 45 amps of current. You can add more power MOSFETs in parallel to increase current capacity and to lower the overall RDS(on) of the FETs.

Final Advice

First, this is by no means the best circuit in the world and there will always be room for improvements. I'm not totally happy with the gate driver as it is not fast enough to fully turn off, causing some distortion. A better driver circuit would improve operation. Also, I noticed some of the harmonics from the voltage pump appearing on the gate of the FET. Adding a 0.001 cap from the gate to ground shunts this stray RF to ground, but it also adds extra capacitance to the FET gate. I'm working on a voltage pump using a small transformer to totally remove any RF from the system. Yes, there are special high-side driver chips on the market, but they're expensive and hard to get right now.

By breaking the connection from the 100k 1% resistor and the 20k 1% resistor from the PC trace you can use remote battery sensing. This point would then connect directly to the battery and not to the terminal block on the PC board. One more LM324 would give us low battery sensing, too, or perhaps a low voltage disconnect. Perhaps on the second generation I'll include these features.

I've noticed a bit of a bug every now and then in the over-temperature shutdown. I can't place my finger on it, but it looks like an offset problem with some LM324s. At very low battery voltage the over-temperature shutdown won't! As the battery's voltage increases, everything works as planned. I'm working on the problem.

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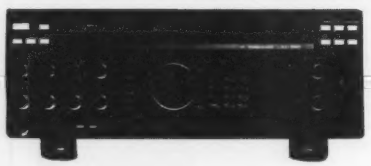

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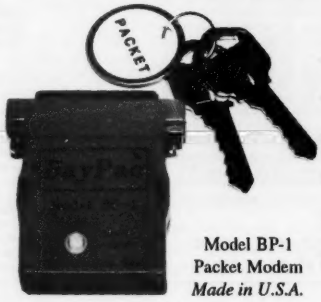

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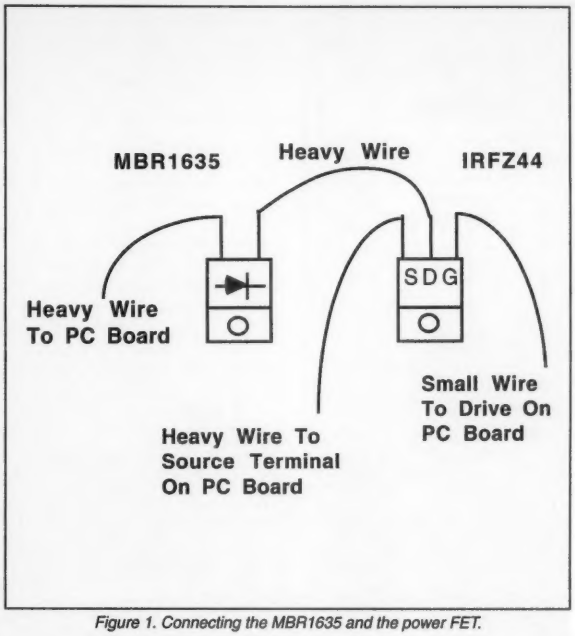

Figure 1. Connecting the MBR1635 and the power FET.

mercial power supply instead of a PV array. Just connect the power supply to the PV terminal and set its voltage to 16 volts. The supply should have current limiting, as a low battery may draw more current than the supply can produce.

I presented the controller as a project to get one's feet wet with power MOSFETs. I hope everyone has picked up a few ideas along the way. The market is always changing, and the power MOSFET is certainly not being left out. Today, the buzzword is 3.3 volt systems. Everywhere you look, you'll see a new specialized chip to work on 3.3 volts. The power MOSFET of yesterday required +10 volts to fully turn on. Now on the market are the newer power MOSFETs that you can saturate with TTL logic (+5 volts). The aim is to have a fully saturated gate with as little as 3.3 volts. The "on" resistance of the power MOSFET continues to fall. It's now possible to get "P" channel power MOSFETs with an RDS(ON) of less than 0.05 ohm. They're expensive, about $19 each, but the price will continue to fall as more and more are made.

Even though the devices are rather rugged when soldered in the PC board, I've found that those with the lower RDS(ON) seem to be more picky about static discharges than FETs with a higher RDS(ON). I can't prove this theory, but all of the FETs I've zapped have been ones with a very low RDS(ON). So, when you're working with these devices, take time to avoid static discharges. Wear a wrist ground strap and use a grounded soldering iron.

You may also have some trouble locating power MOSFETs. It seems they're in quite a demand as a major component in the anti-lock brake systems used in today's automobiles. A number of times I've ordered IRFZ42s only to be told they're out of stock and back-ordered.

If you can't find all the parts needed for this project, drop me a line. I have most of the hard-to-get components in stock here. This includes the terminal block and the trimmer, as well as the power MOSFETs.

Coming Up . . .

In the coming months, I hope to have a working version of an amplifier based on N5NNN's version. I don't want to re-invent the wheel, but there will be some added features to this rig. Stay tuned.

Also, if you have built the little Two-Fer from two months ago, I'll be showing you a small self-contained T/R controller using a power MOSFET instead of the QSK circuit on the Two-Fer board. It will work in just about any home-brew QRP rig. I'm sure you'll find it interesting.

Of course, let's not forget that this month it's Field Day. Keep an ear open for me on 40 meters running home-brew gear this year. Solar-powered, of course, with battery backup at night.

Next month we'll look at some repairs to the very popular Ten-Tec Argonaut 509. Although it's a rather old rig by today's standards, it's still a QRP workhorse. 73

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Edge Of Space Sciences

One of the more prolific amateur radio balloon groups can be found in the Denver, Colorado, area. With over 100 members, the Edge Of Space Sciences (EOSS) group is a nonprofit corporation that promotes science and education via amateur radio and high altitude balloon experiments. They provide high school and university students with an opportunity to conduct scientific experiments at "near-space" altitudes in excess of 20 miles (100,000 feet). The EOSS group provides the transportation and balloon payload framework, and organizes the launch and recovery for these experiments. This is a great opportunity for all participants to learn how to design, launch and track what is for all practical purposes a small spacecraft (actually an "edge of space" craft).

Research and Education Possibilities

Students now have a chance to conduct a variety of experiments that were simply unavailable or unaffordable in the past, when they could fly their experiment either on the space shuttle or on a very large NASA research balloon. These options usually require a lot of lead time and the waiting list is long.

Through the efforts of the many members of EOSS, students now have a relatively easy and inexpensive way to study the atmosphere, environment and space.

EOSS has conducted over 11 balloon flights since its incorporation, all with extensive student involvement. Gaining from their flight experience, they have developed a reliable system that relays telemetry (altitude, temperature, system voltage and experiment data) back to mission control through the use of an onboard flight computer that sends down the data via packet and CW. They usually fly an ATV system on 426.25 MHz, providing a live TV camera view of the earth, the balloon and the experiment. They can uplink commands to the payload to activate and control experiments, rotate the mirror in front of the TV camera, or release the payload from the balloon for recovery.

Their current system is called the EOSS "Shuttle" and is a reusable framework for downlinking ATV and telemetry (see Figure 1 for system details). EOSS has flown a number of flights using a standard weather balloon. Unfortunately, these balloons burst at peak altitude and the payload immediately parachutes back. Although very inexpensive, this type of flight usually lasts about two to three hours, and the time in near-space is limited to a short period.

To allow their package to float at altitude for extended periods of time, the EOSS group has been using a plastic "zero-pressure" style of balloon. Although more expensive than a rubber weather balloon (but not unaffordable), this balloon starts out at liftoff as a large bag of plastic with a small bubble of helium in the top (see Photo A). It is fully inflated at peak altitude and vents out excess helium until it reaches an equilibrium. It will stay at altitude until it loses excess solar lift. After sunset, it will start a slow return to earth unless ballast is dropped. One of EOSS's first flights using this type of balloon stayed up 18 hours and landed over 200 miles away, in Nebraska, around 5 a.m.! The dedicated (and travel-weary) chase team had followed it through the night and quickly recovered it.

Photo A. The sixth EOSS flight used a large zero-pressure balloon to carry a student solar telescope aloft. It was dubbed the "Humble Telescope."

These long-duration flights have many possibilities. Imagine a VHF FM or an ATV repeater with a consistent 400-mile range! Some of the more advanced EOSS payloads have included a solar telescope, a Loran C position downlink and a gimballed mirror TV camera system to allow the ground crew to remotely control the view from the payload (downlinked via ATV on 426.25 MHz).

Their next mission will fly a student experiment which will test differential GPS (Global Positioning System).

National Balloon Symposium

In an effort to bring together members of the various balloon groups, educators, students and scientists to share information, EOSS is sponsoring the first ever National Balloon Symposium. It will be held at the Holiday Inn at the Denver International Airport (Denver, Colorado) from August 20-22.

Friday night will be a social event for viewing payloads and launch videos, and meeting the other attendees. On Saturday, papers will be presented by nationally prominent balloon experimenters, educators, scientists and authors. Topics will include such

Photo B. The payload for the first EOSS flight carried a TV camera and ATV transmitter aloft. The flag was used as a rudder (packaging by Dave Clingerman W6OAL).

Photo C. During the tenth flight, this payload carried an experiment designed by university students.

areas as the general history of ballooning, payload construction and testing, flight systems, regulations, tracking and recovery, high altitude physics and plenty of tales and yarns about various flight experiences. EOSS will sponsor a luncheon at the Saturday meeting. A balloon payload workshop will be offered on Sunday, as well as (if the weather permits) an opportunity to launch and track an actual balloon experiment.

For information about the symposium, contact Edge Of Space Sciences (EOSS) at 376 West Caley Circle, Littleton CO 80120; Tel: (303) 794-5624.

To submit a paper for inclusion in the proceedings and/or for presentation at the symposium, please contact Ann Trudeau, 15487 E. Bates Ave., Aurora CO 80013; Tel: (303) 690-1669. Any group that would like to launch their own payload on Sunday from the symposium, please coordinate with Marty Griffin, 1647 E. Geddes Circle N., Littleton CO 80122; Tel: (303) 794-3458.

If you are interested in starting up your own balloon group or have an interest in this kind of amateur radio activity, this should be a fascinating event. *Thanks to EOSS president, Jack Crabtree AAØP, for the above information.*

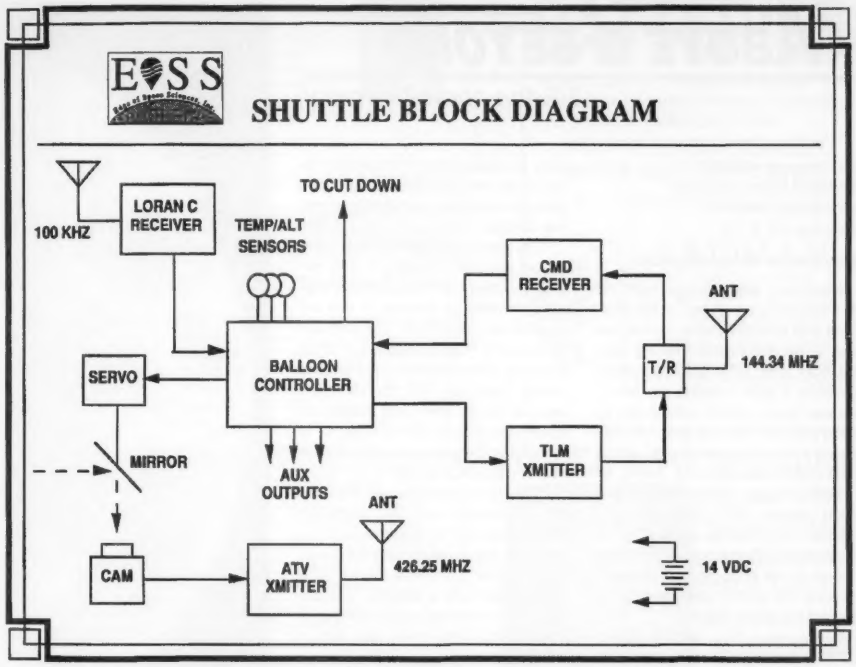

Figure 1. The EOSS "Shuttle" package consists of a reusable framework for downlinking video and telemetry from student experiments. Command capability is included via a VHF uplink.

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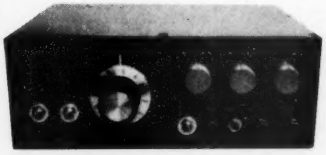

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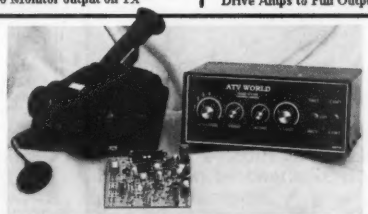

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Microwave Moonbounce

Microwave moonbounce might not be everyone's cup of tea, at least not those who think microwave communications is line-of-sight only (implying short distances only). Long-distance communications is quite possible on the microwave bands, and to prove it let's go to the extreme: moonbounce. This path covers communications of over a half-million-miles. Possible? Yes, indeed. As a matter of fact, communication was made between WA7CJO in Phoenix, Arizona, and G3WDG and G4KGC in England on 10 GHz moonbounce. What follows is the account from G3WDG covering this contact and some of the methods he used to make it.

"On January 31, 1993, at 2230, G3WDG and G4KGC made two EME QSOs on 10 GHz. This is believed to be the first made on this band from the UK. The initial QSO was with WA7CJO in Phoenix, Arizona, at 2230. This was the second attempt. The first test on January 30 was partially successful as WA7CJO was heard at good signal strength at G3WDG's location for a one-way contact.

"The antenna in use in the UK was a 10-foot solid dish (Andrew 11 GHz version) mounted on an El/Az mount originally intended for satellite TV use but modified for motor drive. The dish was scraped off from a local electronics company where G3WDG used to work. During Christmas 1992 the foundation was laid for the tower and a week before the first test the dish was put into its mount and the elevation azimuth drive motors were also installed.

"The rest of the equipment consisted of a Hughes 28 watt TWT amplifier. WA5VJB and KY7B helped in acquiring this tube and in refurbishing the power supply. The TWT was driven by a G4DDK-004 and a G3WDG-001-designed transmitting module for use in the 10 GHz system. An early design G3WDG-004 prototype HEMPT preamp was used to drive the receive converter, and a G3WDG-002 10 GHz converter was used in the 10 GHz converter. (Note: Designations such as G3WDG-xxx indicate different modules that are

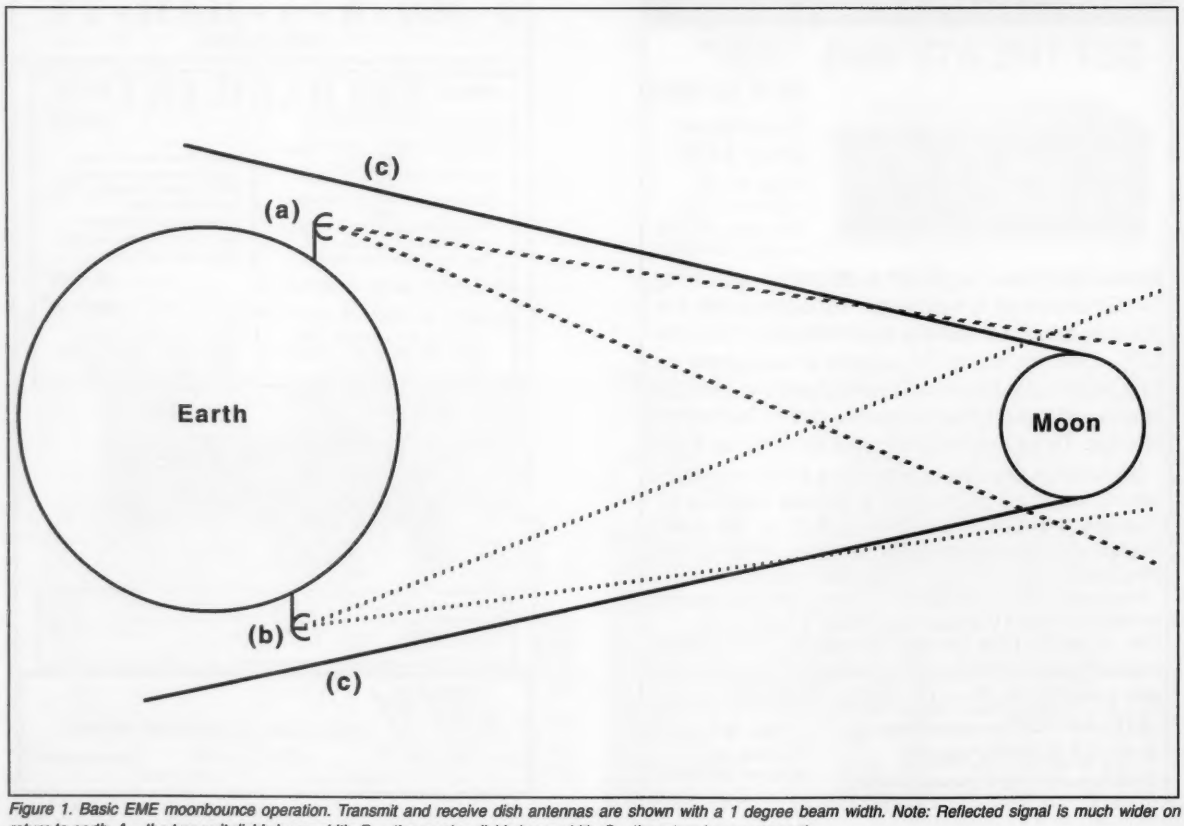
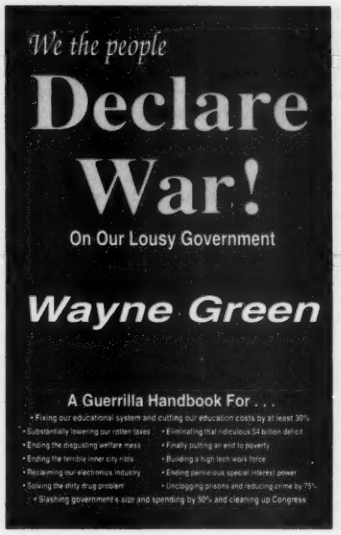


Figure 1. Basic EME moonbounce operation. Transmit and receive dish antennas are shown with a 1 degree beam width. Note: Reflected signal is much wider on return to earth. A = the transmit dish's beamwidth; B = the receive dish's beamwidth; C = the return bounce to earth.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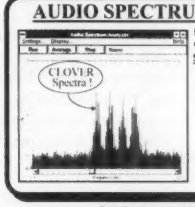

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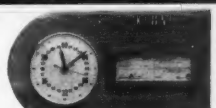

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available for 10 GHz construction in the UK).

"The output from the 10 GHz converter was split into two channels. One was fed into G3WDH's shack, feeding the 144 MHz receive system. The other feed supplied a 2-MHz-wide 70 dB gain block connected to an indicating power meter. The function of the power meter feed was to give visual indication when the dish was correctly aimed at the moon.

"The power meter was then used to read 'moon noise,' the increase in noise when the dish antenna is accurately aimed at the moon. The reference noise is that which occurs when the dish is pointed on nothing specific (cold sky). An increase in the residual noise reading on the power meter (when aimed at the moon) is a usable indicator that your antenna is in proper position for moonbounce work.

"In actual operation the moon noise measured 1.7 dB above cold sky noise at G3WDG's location, with a 1.25 dB noise figure preamp being used. A more sensitive (lower noise figure) preamp (0.75 dB noise figure) was not used at the time because it might be destroyed by the transmitting equipment. It was held in reserve for later tests.

"The standards for indicating signal readability on moonbounce signals are the 'O' and 'M' reports. These are standard EME signal reports: 'O' signifying easy copy, and 'M' difficult copy. In RST terms, G3WDG copied WA7CJO at 539, and later copied SM4DHN at 529. SM4DHN would have been 3 dB stronger if all stations were using the same polarization for the dish feed systems. Note: Both G3WDG and WA7CJO were using linear feeds; SM4DHN was using circular polarization.

"Signal reporting is done with 'O' and 'M' reports in CW; these are the standard EME signal reports used. I presume they use them because they are quick and easy to identify what is going on in a very fast action. When 10 GHz signals bounce off the moon they have a rough note similar to rain scatter, but not as rough. This is a CW signal with all the dots and dashes there, but with a rough note.

"It's kind of hard to explain this rough note. It is not pure CW as you hear on low frequency bands but, as I refer to it, a sort of a 'CUSH' sound. If you slur the word 'CUSH' the resulting noise resembles the returned CW note, with a short 'CUSH' being a 'DOT' and a long 'CUSH' being a dash.

"Back to the power meter and the tracking part of the system. The moon noise tracking method was recommended by WA5VJB and KY7B and it worked extremely well. With this system in place it was very easy to keep the dish exactly on the proper heading, despite the very narrow antenna beamwidth (about 0.7 degree). A sighting telescope had also been fitted to the dish mount but, as always happens in the UK, it was 100% cloudy on the 30th and 31st. The dish positioning had to be updated by reading moon noise on the power meter at least every minute to keep the dish in proper orientation, pointing at the moon.

"An alternative to checking dish aiming and system receive operation is to check sun noise. You guessed it! Cold sky noise is when the dish is pointing at nothing in particular. Sun noise is of course much larger than moon noise and whichever you use, both work well. The reports from the UK indicate that with the sun at a very low sun position they were able to get 3 dB sun noise with the sun shining through a hedge."

Concerning the use of smaller dishes, Charlie G3WDG states that both WA7CJO and SM4DHN should be receivable on dishes smaller than his 10-footer. His calculations show that readable signals should be obtained with dishes as small 1.2 meters (that's four feet in diameter), with a very good low-noise preamp, of course. Charlie states that both WA7CJO and SM4DHN have quite good equipment: WA7CJO has a 5 meter dish and 350 watt output, and SM4DHN uses a 6 meter dish and 70 watts of power on 10 GHz.

Another interesting feature with moonbounce is that you do not need another station to be there to determine if you can successfully bounce signals off the moon. This can be verified by your own station. You transmit towards the moon and a few seconds later you should be able to hear your "echo" reflected back at you. Due to Doppler shift, the return frequency is not the same as your transmitted frequency, but is shifted higher in frequency. In this test from G3WDG he received the echo 14 kHz shifted in frequency. The signal was weak yet had quite consistent echoes, loud enough to have worked if it had been another station.

This should get you spurred up into thinking about EME contacts on microwave. Contacts of this sort are not limited to 10 GHz, but rather any band between VHF and microwave are possible. The equipment required is kind of specialized, but with a little scrounging you can put it together, if you put your mind to it.

EME Moonbounce Program

Path loss considerations need to be taken into account. The formulas are a little bit intimidating, but there are many different computer programs available that will do the calculations for you. All you have to do is answer the questions prompted by the program and it will give you the needed approximations. I have a simple program that is good for beginners in this area as it allows you to play around with the different parameters to find out just what is needed to simulate moonbounce operation. A negative number indicates signals under the noise floor, and positive numbers indicate signals above the noise floor. The more positive, the better the chance of making the system work.

The program asks for simple data like the noise figure of your receive system (1.25 dB), receiver bandwidth (500 Hz), frequency in MHz (10368 MHz), Antenna 1 gain (10-foot dish = 45 dB gain, entered as 0.45), Antenna 2 gain (20 foot = 57 dB gain, entered as 0.57), and transmit power in watts (enter 28W, then let the program go). At the end you can select any one of the data points entered to re-calculate for custom designing. (If this sample data looks familiar it's because it's from the contact described above.) You can not only calculate its effects, but custom tailor the program for your special needs at other frequencies and station configurations as well.

This program is not new for me—it's something that I picked up in the early days of CPM and I found it on my old dinosaur computer (a Kaypro CPM machine from the early '80s). I take no credit for it and do not know the identity of the author or group who generated it. I'm just passing it along for your use. I have run this program on both CPM and IBM formats, using BASIC. This should

Continued on page 77

EME PROGRAM

```
100 REM THIS PROGRAM CALCULATES S/N RATIO OF THE EME SIGNAL
110 REM GIVEN THE EQ DATA FOR AVG EARTH MOON DISTANCE
120 REM AT PERIGEEE SIGNALS WILL BE 1 DB STRONGER
130 REM AT APOGEE 1 DB WEAKER
160 REM NOTE THAT THE REC SENS MAY BE GIVEN AS EITHER
170 REM NOISE FIGURE (NUMBER, > 20) OR NOISE TEMPERATURE
180 REM OR ANT GAIN (ENTER AS GAIN/100). (IE. 9DB =.09)
260 REM GET INPUT DATA
270 GOSUB 350
280 GOSUB 370
290 GOSUB 390
300 GOSUB 410
310 GOSUB 430
320 GOSUB 450
330 GOSUB 480
340 REM SUBROUTINES TO GET INPUT DATA
350 INPUT "SYSTEM NOISE TEMP OR NOISE FIGURE ";N
360 RETURN
370 INPUT "RX BANDWIDTH (HZ)          ";B
380 RETURN
390 INPUT "FREQUENCY   (MHZ)          ";F
400 RETURN
410 INPUT "ANT 1 DIA (FT) OR GAIN (.DB) ";D1
420 RETURN
430 INPUT "ANT 2 DIA (FT) OR GAIN (.DB) ";D2
440 RETURN
450 INPUT "TX POWER (W)               ";P
460 RETURN
470 REM ANTENNA CALCULATIONS
480 D=D1 : GOSUB 530
490 G1=G :A1$=D$ :A1=A
500 D=D2 : GOSUB 530
510 G2=G : A2$=D$ : A2=A
520 GOTO 590
530 IF D<1 THEN GOTO 560
540 D$="FT" : G=(4.3422*LOG(5.094*D*D*F*F))-60
550 GOTO 570
560 D$="DB" : G=100*D : A=G
570 RETURN
580 REM CONVERT NOISE FIGURE TO NOISE TEMPERATURE
590 IF N<20 THEN GOTO 620
600 T=N : NS="K"
610 GOTO 640
620 T=290*(EXP(.2303*N)-1) : N$="DB"
630 REM CALCULATE RECEIVER NOISE POWER
640 R=-228.6+4.3422*LOG(T)+4.3422*LOG(B)
650 REM CALCULATION OF PATH LOSS
660 L=-271+8.684399*LOG(1296/F)
670 REM CALCULATION OF SIGNAL TO NOISE RATIO
680 S=G1+G2+4.3422*LOG(P)+L-R
690 S=INT(S*10)/10
700 REM PRINT OUT RESULTS
710 PRINT
720 PRINT "CODE   PARAMETER     CURRENT VALUE"
730 PRINT
740 PRINT "1    NOISE TEMP/FIG   ";N;N$
750 PRINT "2    BANDWIDTH        ";B;"HZ"
760 PRINT "3    FREQUENCY        ";F;"MHZ"
770 PRINT "4    ANTENNA 1        ";A1;;A1$
780 PRINT "5    ANTENNA 2        ";A2;;A2$
790 PRINT "6    TX POWER         ";P;"W"
800 PRINT
810 PRINT "SIGNAL TO NOISE RATIO  ";S;"DB"
820 PRINT
830 REM GET FURTHER INSTRUCTIONS
840 PRINT "NEW PARAM (1 TO 6), RE RUN (R) OR QUIT (Q)";
850 INPUT A$
860 PRINT
870 IF A$="Q" THEN STOP
880 IF A$="R" THEN 270
890 IF A$="1" THEN GOSUB 350
900 IF A$="2" THEN GOSUB 370
910 IF A$="3" THEN GOSUB 390
920 IF A$="4" THEN GOSUB 410
930 IF A$="5" THEN GOSUB 430
940 IF A$="6" THEN GOSUB 450
950 GOTO 480
960 END
970 RUN
```

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05N

Arnie Johnson N1BAC
43 Old Homestead Hwy.
N. Swanzey NH 03431

Notes from FN42

I had a great thrill on March 21! I had a chance to chat with Rick, Chief Op. for BY1QH and Hambassador to China, for about half an hour on 20 meters. Too bad the conditions were poor at the time, but there is always another day.

It's that time of year again for Field Day. I plan to be actively involved with the KD1GJ effort in Keene, New Hampshire. I won't make it to Colorado for Field Day this year due to my teaching schedule for the summer.

Another story about hams, Silent Keys, and Field Day comes in a letter from P.J. and Ken Opfer, WBØMAL and WAØTOJ, friends from Gunnison, Colorado. P.J. relates a story about going to Fred and Fran Palmblad's house in Colorado Springs to take down a big beam antenna. Fred WØCYM became a Silent Key, and Fran said that the beam antenna should be put up on a hill somewhere where people could see it. The Gunnison Valley ARC felt that the beam should be put to use to honor Fred. They plan to use it during their Field Day activities. Listen for the tribander on the air as WØGYV.

Have a great month and GET INVOLVED! 73, Arnie, N1BAC.

Roundup

Anguilla *Letter and Anguilla ARC Newsletter from John Rouse KA3DBN/VP2EBN:* The newly elected officers of the Anguilla Amateur Radio Society (AARS) are: Dave Mann VP2EHF, President; Dorothea Mann VP2EE, Secretary/Treasurer; Larry Stott VP2EL, Government Liaison and Trustee for VP2EQ/VP2EA; Lou Bardfield VP2EB, Librarian; John Rouse KA3DBN/VP2EBN, Overseas Liaison and Awards Manager. DXers who operate from VP2E are encouraged to join AARS. For information contact KA3DBN at his *Callbook* address.

Generous donations from Angus Chassels (SWL) and Fritz VP2EY brought the cash needed to purchase a WACOM duplexer for the 2 meter repeater. By the time you read this it should be installed at the police communications facility with the "Super Station Master" located at the top of the 75-foot tower. Try it on 144.890 in/145.490 out (+600). A packet TNC set to the network mode and operating on 145.010 MHz will operate at the same location providing island-wide connect capability for the VP2EA PBBS.

Jack Henry N6XQ has donated a turn-key 6 meter beacon to the AARS. Through the good graces of Terry Baxter N6CW/VP2ECW, Jack provided a modified Motorola radio with controller to give the world a Northern Caribbean area propagation beacon on 50.011 MHz. The beacon output is 50 watts; its callsign is VP2EA. *[John Rouse KA3DBN, 2703 Bartlett Lane, Bowie MD 20715 USA.]*

Chatham Island *Downloaded from packet:* A group of nine radio amateurs planned to be at the Chatham Islands from March 1 to March 9, 1993. They planned to operate under the callsign of ZL7AA. QSL information is ZL7AA, c/o P.O. Box 54, Hastings, New Zealand, or second choice, c/o ZL2AL at the *Callbook* address. Those who wish to QSL direct please send a self-addressed envelope with sufficient postage for return posting, otherwise all QSLs will be via the QSL bureaus in the respective countries. *[Information forwarded by ZL2AMV @ ZL-BQK.#40.NZL.OC from details supplied by convener of the DX Group ZL2ARF, John Lane.]*

Finnish Net/USA *Downloaded from packet:* The Suomi (Finnish) Net meets on approximately 7234 kHz, Monday, Wednesday, Friday, and Saturday at 10:30 a.m. EST. We welcome any Finnish-speaking hams to join us even if they don't have good linguistic abilities. It's lots of fun, and I'm sure you will enjoy it. 73 from Willie W8YNY, Crystal Falls, Michigan.

Honduras *Downloaded from packet from Jorge Escotto HR2JAE @ WØXK:* If you have had contacts from HR stations without an answer, please send us your package certificate with the QSLs unanswered. Add an envelope for each one and do not forget the mail cost. Send to: U.R.E.H. Bureau, P.O. Box 73-73, San Pedro Sula, Honduras, C.A. Our bureau will contact those people and help them answer. If you have already sent IRCs or postage stamps, please advise us also. Many thanks from the Union de Radioaficionados Experimentadores de Honduras (UREH).

Japan *From the JARL Newsletter:* According to the IARU calendar, the Chinese Taipei Amateur Radio League (CTARL) joined the IARU as its 126th member as a result of voting by all IARU member societies.

CTARL was founded in 1991, and the number of its registered members at the time of application was 79. Mr. Tim Cheng BV2A/BV2B has been named president, and Mr. James Fang BV2BO director of its Secretariat. All correspondence may be addressed to CTARL, P.O. Box 93, Taipei, Taiwan.

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endar are May 30th, the 35th General Assembly; August 20-22, 1993 Amateur Radio Festival; and October 31, All-Japan ARDF Championship.

The JARL received a Fax from the Chinese Radio Sports Association (CRSA) saying: "Opening of individual amateur radio stations has been permitted and the first such stations are to operate from 10 o'clock, the morning of December 22, 1992. The prefixes of their callsigns are BA, BD, and BG." The stations will be set up and operated by none other than individual amateur radio devotees and used solely for self-training, mutual communication, and technological studies. Those desiring to set up a station must obtain permission from a nearby Radio Station Control Committee. Additionally, they must obtain a radio station license before actually putting the station to use.

Mongolia *Letter from T. Naranbaatar JT1BV:* Greetings to you from Mongolia from the president of "Descendants of Chinggis Khan" International Radio Club. The club was set up in November 1992 to immortalize the memory of Chinggis Khan (king) and his successors during the Mongolian Empire. Anyone can join our club. The club callsign is JT1V. We are pleased to sponsor several awards: Chinggis's Chronicle; Ugedei's Chronicle; Hubilai's Chronicle. For further information, either for membership or the awards, please contact us: Descendants of Chinggis Khan International Radio Club, P.O. Box 106, Ulaanbaatar 51, Mongolia, Central Asia; Telephone: 32-84-02, 56-0-32; TLX: 79264 BUFAM MH; Fax: 976-1-310060.

Mozambique *Downloaded from packet from ZS5S @ K2PPH:* As of March 7, 1993, new callsigns came into use in Mozambique and now conform to the ITU standard. John, ex-C9RJJ, now-C91J, reports the new callsigns recently assigned: C91-C96 will be the normal calls with C97, 98, and 90 for possible special events. It was proposed that C99 be used as a sort of Novice call (VHF privileges only). It is still not clear, but provision will be made for visitor operators and they probably will be authorized to sign /91. John also reports that the Department of Telecommunications in Mozambique is sympathetic towards amateur radio and is very cooperative. Radio classes have started recently and there are seven enthusiastic participants. 73 de Joe ZS5S, Sysop Aplink S. Africa. *[HURRAH!!—Arnie]*

Russia *Downloaded from packet, NT2X and WB2DHY:* Russia is considering new guidelines for visiting foreign amateurs. Under consideration are: 1) RV7 callsign series to be assigned to foreigners; 2) Exams to be passed; 3) New paperwork, application with request from a Russian sponsor; 4) Some sort of fee will be instituted, in hard currency, for the license. All this is in the process of development and nothing is firm at this time. I'll try to find out more and pass it on. 73, Ed NT2X.

Russia/Ukraine/Lithuania/Bulgaria *Downloaded from packet:* The popularity of communications with the ex-republics of the former USSR has prompted this list of packet bulletin boards: UZ3AXO.#MGU.RUS.EU, Moscow State Univ.; RS3A.#MSK.RUS.EU, Kremlin, Moscow; RK3KP.#MSK.RUS.EU, Moscow; UA6LU.RUS.EU, Rostow; UA6LQ.RUS.EU,Rostow;UZ9CWW.RUS.EU, Ekaterinoburg (Sverdlovsk); UZ9OWD.RUS.EU, Novosibirsk Tech. Univ.; UT4UX.UKR.EU, Kiev; UB5LMJ.UKR.EU, Kharkow; U5WF.UKR.EU; LY2WR.LIT.EU, Vilnius; LZ2XA.BUL.EU, Sophia. Many thanks to KA2JXI and UA3CR. If you know of other BBSs in the former USSR, please pass them on to Dick N1MDZ @ K1RQG.ME.USA.NA.

Switzerland *From the International Telecommunication Union (ITU) Press Release:* Three new members have joined the ITU since the beginning of the year: Georgia, 7 January; Slovakia, 23 February; Kazakhstan, 23 February. As of 23 February, there are 176 members of the ITU.

BRAZIL

Carlos Vianna Carneiro PY1CC
Afonso Pena, 49/701
20270/240 Rio de Janeiro
Brasil

Well! We are having troubles delivering DX QSLs to the IARU Bureaus and we hope you'll accept our reasons, giving us credit for trying, for we are all rowing in the same boat.

Since 1934, when LABRE, the Brazilian Radio Amateur League, was formed, we have had a separate branch in each of our 26 states, with the LABRE managing the QSL Bureau. But, little by little, the expenses have been making it impossible to be managed by LABRE alone. LABRE's statutes were modified in June 1992 to pass the responsibility for delivery of QSLs to each of the branch organizations, a sudden nightmare for almost all of them. Because of the increased expense, each branch was certainly not ready to face this problem.

We are having no problem receiving DX or Brazilian QSLs; it is the return that we are having problems with. We're working hard to find our way out, and I'm sure we will, but please be patient.

ISRAEL

Ron Gang 4X1MK
Kibbutz Urim
D. Negev 85530
Israel

Seventy Centimetres Under the Gun On January 12th, 4X6ZH, the IARC repeater coordinator, dropped a bombshell on the weekly IARC net. Isaac stated that far-reaching changes

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are in the offing for our 430-440 MHz band (presently used on a shared basis, with amateur transmissions being on a secondary non-interfering basis). He said that we amateurs are in a STATE OF EMERGENCY insofar as 2 megahertz of the band are to be given away to the major two-way communications company in Israel for commercial use. Although there had been some vague rumors in the past, nothing had been stated publicly about the possibility of being dispossessed of some of our prime spectrum.

Although still under-used, with 2 metres fully occupied and all the Phase 3 and Microsat satellite activity utilizing 70 centimetres for up and downlinks, 430 MHz is prime real estate for near-future amateur activities, a very important part of our spectrum.

Then, just over a week later, the January IARC *HaGAL Magazine* appeared in our mailboxes. The published minutes of the September 13th (!) IARC Executive meeting let the cat out of the bag:

"Peleg (4X1GP) reports that the mobile communications (service) is in dire need of frequencies. The national frequencies committee (of the Ministry of Communications) appointed a subcommittee, and it recommended that 7 megahertz out of our UHF range be taken for the benefit of other elements. A sitting of the frequencies committee in which Peleg was present turned down the recommendation and decided on the allocation of 2 megahertz for the mobile service and didn't state from where. The committee was instructed to hold a technical meeting to find a way to integrate the mobile service into the amateur allocation."

For years the Ministry had forbidden the hams to establish new repeaters on the 70 centimetre band. Activity has been mainly on the 438.650 Tel-Aviv and 438.800 MHz Haifa repeaters (input 7.6 MHz down), a few sparsely used simplex channels throughout the band, Ralph 4X1IF working moonbounce and tropo on 432 MHz, and a smattering of satellite activity between 435 to 436 MHz by a handful of amateurs.

Now a sudden awakening has come, "Use It or Lose It," with plans for moving the old Tel-Aviv UHF machine down to Beersheva and a link for packet forwarding on 70 centimetres. The fact may well be that this is all too little and too late. There is a sense of outrage on the part of many hams and questions about what has been going on behind the scenes. On that same IARC Tuesday evening net when 4X6ZH "spilled the beans," one of our elected officials urged us not to discuss the matter on the air, but to wait for the IARC annual membership assembly on February 25th when all will be told. For sure, there is now a vital issue at stake, and that get-together promises to be a hot one. *[Does this sound familiar to the hams in the United States, the "taking" of 2 MHz of the 220-225 MHz band? Commercial interests, and money, talk! As Ron says "Use it, or lose it!" And there is no guarantee that even if we use it, we will not lose it.—Arnie]*

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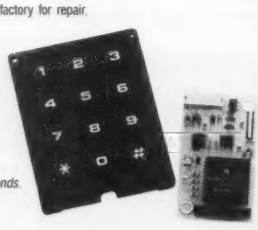

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David Cowhig 7J6CBQ/WA1LBP
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In early November I made a short visit to Taipei (BV). The xiangchangzu "sausage tribe" of Taiwan now has grown from one to over 1,800 members over the last few years. Ham radio, personal radio, and a wide array of business radio services became available to the general public about three years ago when martial law ended. Who uses what frequency hasn't quite been settled yet. In one shop in the Pa Teh Lu electronic row an ICOM 2 meter handie was described as a CB radio and 144.800 MHz as the frequency used by motorists to exchange traffic information. In a second shop, a salesman said that businessmen buy ham equipment by day and hams buy it by night. In a third ham radio shop I met a self-described "underground ham" who talks with friends on 2 meters while he studies CW for the Taiwan ham examination. He told me that Taiwan has tens of thousands of unlicensed 2 meter operators. I see no trace of unlicensed operation on HF, though. All the BVs I have spoken to on HF from neighboring Okinawa are fine operators. Once Taiwan has adjusted to this revolution in radio availability, the number of licensed hams will certainly be far higher than it is today.

While in Taiwan I bought several issues of two Chinese language magazines which cover ham radio extensively. *Yeyu Wuxiandian (CQ Amateur Radio Magazine)*, Shin Sheng Rd. Section 1, Lane 56 No. 12 fourth floor, Taipei, Taiwan, is published semi-monthly. The September 1992 issue discusses the Taiwan-Korea-Japan-Russia 430 MHz test in late July, the Taiwan 2 meter packet BBS network, the progress of the China Taipei Amateur Radio League founded March 1, 1992, the June 1992 annual amateur radio examination given in Kaohsiung (344 of 555 passed the exam), 10 pages of Japanese lessons for Chinese hams, Shane BV2FA's report on ham radio around the world, and an article by Lin Polung BV5AF on the WA7BML packet RBBS adapted for English and Chinese language packet radio in Taiwan.

The second magazine, 41-year-old *Wuxiandian Jie [Electronics and Radio-TV Technic]*, Pa Teh Road Section 2, Lane 312, Number 19 Sixth Floor, Taipei, Taiwan, expanded its coverage to include ham radio. The November 1992 issue included ads for several Taiwan brands of VHF and UHF handie-talkies such as Pro-Power and Union, a 200 watt output 2 meter amplifier with GaAs FET preamp from Aria, and several Taiwan-made ham antennas. Articles discussed radio propagation, antenna construction, frequency checking, how the Global Positioning System (GPS) automobile navigation systems work, setting up your first ham radio station, the Taiwan packet BBS network and its APLINK connection through BV5AF on 14.072 MHz LSB mark, basic transmitter principles, a four-page article about the radio-electronics inventors Russell and Sigurd Varian by Qing Shan, plus articles on SCR motor control, introduction to optoelectronics, railroad electronic monitoring and control systems, bar codes and bar code readers, digital image processing, remote control of PCs by telephone, a 10 mW QRP AM transmitter, and installments in series on elementary electronics and radio technology. This 160 NT (US $6) magazine with its 150 pages of advertisements and 200 pages of articles reflects the robust good health of the Taiwan electronic industry and, incidentally, the role that ham radio now plays in Taiwan in training a new generation with a sophisticated knowledge of radio and electronics technology.

PEOPLE'S REPUBLIC OF CHINA

Rick Hunter, Chief Op BY1QH
Room 316, Building 25
Tsinghua University
Beijing 100084
People's Republic of China
Packet: BY1QH @ JA5TX.JPN.AS

More than 30 Chinese Amateur Radio Veterans spent a lovely day at BY1PK, the Headquarters of the China Radio Sport Association (CRSA), on January 20 in Beijing. Many of them were friends before 1949 and seeing each other again in this special place has turned out to be something quite exciting. Mr. Tong BZ1AA and Mr. Chen BZ1HAM were present on behalf of the CRSA.

TUARC has been honored by visits from many other hams. Some of those have been: Dieter DJ7BU, a German engineer at Siemens, with friends Meng BZ1FB and Ling BZ4ROM; Benny BV4HF, a 23-year-old medical student; Mr. Li Liang BY2SY and Miss Du Fan BY6NZ.

We have been very pleased with the response from many who have wished to exchange flags with us. We look forward to many more. We are now on the WARC bands using a Kenwood 440S and a ground plane vertical antenna. Sorry, CW on 12/17/30 meters is not available at this moment.

Our thanks to many who have sent us messages and talked with us on the air. Our continued thanks to those who pass this information on to the rest of the world via packet and magazines. What questions do you have? We would be glad to answer them for you.

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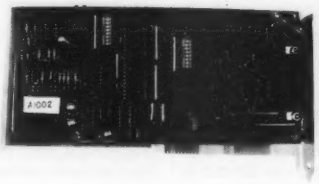

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CIRCLE 168 ON READER SERVICE CARD

ABOVE & BEYOND

Continued from page 72

give you some insight into just what is needed to pull off a moonbounce contact.

I hope you use this program to evaluate your typical station for moonbounce operations. It will give you a good idea of what is going on and will allow you to assemble your specific station requirements for successful operation.

Mailbox Comments

Ian Hunt of Bridgetown, Australia, questions the availability of the 10 MHz standards that I made available quite some time ago in this column. Ian, I am sorry to say that the oscillators were a bigger hit than I expected. They went fast and are now all gone. I even managed to pick up an "unheard-of" second bunch from the same surplus dealer who had the first; even these are gone. If I can find another bunch of 10 MHz oscillators of reasonable accuracy I will pick them up and let you know.

I wouldn't have even made the oscillators available if it hadn't been for Bill Brown WB8ELK—I just did not think that there would be any interest in them. However, Bill wanted high accuracy oscillators for an article covering modifications to a Heathkit frequency counter and had difficulty in locating them. Our connection was sheer accident. Too bad I was not able to pick up a larger amount of the surplus oscillators. I'll keep my eyes open and make you aware if anything shows up.

Joel KØ4AB inquired about the suitability of a Microwave Sensors, Inc. Model D8 microwave motion detector for 10 GHz operation (it uses a Microwave Associates MA86763 unit): "Is this unit suitable for 10 GHz operation, and do you know where I might find a surplus source for more of these units? Also, are the 30 MHz IF boards still available from you?"

Well, Joel, I haven't seen your particular unit but most of them on the market operate the same: power (DC) to the Gunn diode and connection of the detector diode to a suitable IF amplifier for receiving. All units are suitable for 10 GHz operation as they were intended for operation on 10,525 GHz for commercial operation. They usually have a frequency adjust screw allowing them to be re-adjusted into the amateur portion of the band. Also, the IF, a 30 MHz receiver PC board, is still available and the cost is still $10 for the TDA-7000 and a PC board with a few parts tossed in. For a surplus source for microwave alarm units, check your local burglar alarm companies.

That's it for this month. As always, I will be glad to answer questions concerning VHF and microwave topics. Please send an SASE for a prompt reply. 73 Chuck WB6IGP.

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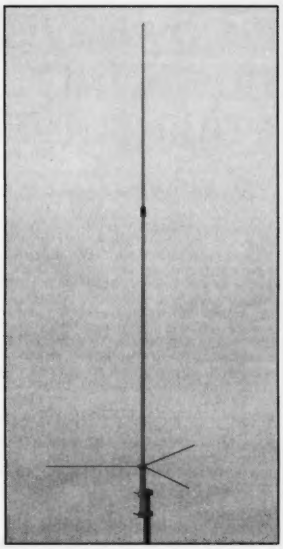

SENSIBLE SOFTWARE SOLUTIONS

CopyCode from Sensible Software Solutions is a Morse code trainer for the Amiga computer that can be used to upgrade your amateur radio license. All controls—including frequency, volume, weight, character formation and transmission speeds, lesson length, and hide/show text—may be set by using a mouse. CopyCode contains all the characters on the FCC exam, and more. You can practice with the 14 predefined character groups or create your own groups using a unique on-screen keyboard. CopyCode contains thousands of random but repeatable sequences of characters, words, Q-signals, CW abbreviations and QSOs. You can also run multiple copies of CopyCode to practice receiving CW through QRM.

CopyCode is priced at $23. For more information, contact *Sensible Software Solutions, 4951-D Claremont Square, Suite 262, San Diego CA 92117-2798; (619) 452-1938.* Or circle Reader Service No. 202.

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For the price and more information, contact *NCG, 1275 North Grove St., Anaheim CA 92806; (714) 630-4541, (800) 962-2611, Fax: (714) 630-7024.* Or circle Reader Service No. 203.

THE GRAPEVINE GROUP

The Amiga Troubleshooter by Ian Perry of Wilcom Australia Ltd. is a simple guide to diagnosing faulty components (especially ICs) on Amiga A500/A2000 computers. The Amiga Troubleshooter is a diagnostic tool that takes you through logical steps, leading you directly to the source of your problem in seconds. A very high percentage of Amiga problems are readily fixed by simple substitution of integrated circuits (ICs) in existing plug-in sockets. The novice, as well as the experienced technician, will find it simple to use. No other tools or equipment are needed.

The Amiga Troubleshooter is priced at $12.95. For more information, contact *The Grapevine Group Inc., 3 Chestnut Street, Suffern NY 10901; (914)-357-2424, (800) 292-7445, Fax: (914) 357-6243.* Or circle Reader Service No. 201.

Continued on page 82

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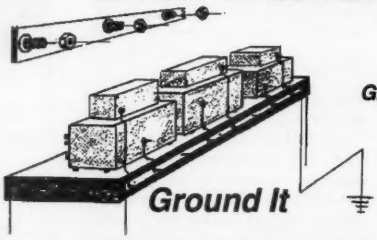

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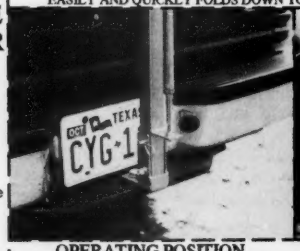

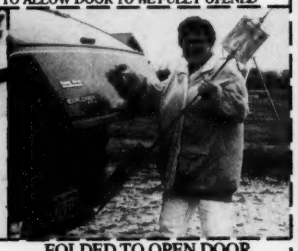

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The 73 Flea Market, Barter n' Buy, costs you peanuts (almost)—comes to 35 cents a word for individual (noncommercial) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham sure it still works right and maybe you can help make a ham newcomer or retired old timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

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The deadline for the July classified ad section is May 13, 1993.

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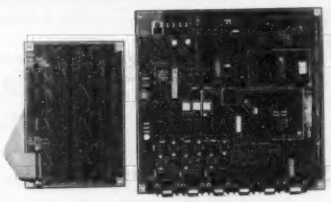

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NEVER SAY DIE

Continued from page 4

repair. It doesn't take much to screw up the DNA replication process, which is going on constantly as new cells are built and old ones phased out. The sharp wave fronts of CW square waves, which go from a few hertz on up into the microwaves, can't improve how our cells replicate and could help explain why hams have about double the deaths due to cancer as the general public. It might be worthwhile to find out if hams are any more susceptible to long-range illnesses than other people. When you mess up cells, you don't know what's going to break down. It could be more than cancer.

If you have a need for a reference guide to the published research papers in this field there are 21 pages of references on the *73* BBS . . . so far.

Cellular radios and cancer? I'll be amazed if there isn't a connection.

Me? A Bore?

Forsooth! Well, I can be when faced with a contact with someone who just refuses to talk. Is it residual mike fright which has persisted for decades? Some of these non-talkers have some fairly old callsigns. Is it that they've never done anything? Never read anything much? Never gone anywhere? Never really thought? No, I'm sure that if I could sit down with them I could pry some interesting stories out of them.

Many of the DX ops I talk with are bitterly critical of American operators. All Americans seem to want is a QSL card! Many American ops seem to have had their contact formula spiels frozen at around the time of their first contact. Well, it's a lot easier than having to think. Thinking, apparently, is hard work. Well, I suppose so. It's something which is battered out of us in school, where a thinking student is a teacher's worst nightmare. It's almost impossible to beat a habit mercilessly pounded into us over 16 years of school.

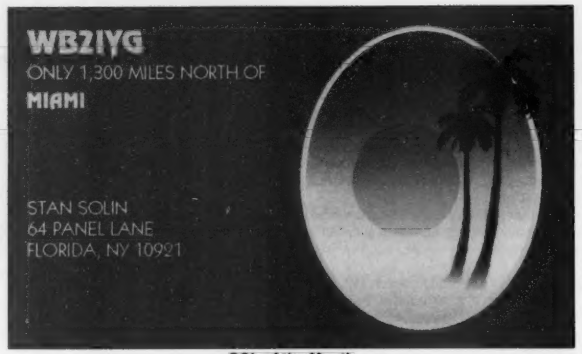
Our whole society is built around not having to think. TV provides us with endless semi-entertainment that seldom demands any actual thinking. Movies are geared to entertainment, not thinking. Most business is routine and thinking is punished when it interrupts the routine. Talk with friends is mostly blather, with no sign of thinking involved. Gossip. The reason *US* and *People* magazines were started is because too few people could cope with *Time* and *Newsweek*. The news magazines tended to call for some thinking, something Donahue, Oprah, and *US* don't.

A Cultural Straitjacket

The wonder is that a few American hams have managed to break free of this educationally and culturally built straitjacket and are able to conduct interesting, intelligent conversations over the air. The one-way nature of our contacts which, despite improvements in communications technology, we fiercely refuse to drop, makes it much more difficult to talk than a normal two-way conversation. I sure hope a few hams will start working on some practical duplex systems so we can make talking easier.

We can do this via frequency separation, so we can both transmit at the same time, or we might do it via time splitting, where we share a frequency but send sound samples several thousand times a second. This would allow us to have as many as six or seven people all talking on the same frequency at the same time to each other, with everyone hearing the others.

In the meanwhile, if those of us who are looking for more than a QSL card out of a contact can make a serious effort to get others to actually talk, perhaps in another generation we'll begin to see some results. We might establish some special frequencies for actual non-QSL contacts. Do you think there is any potential for conversational nets?



QSL of the Month

To enter your QSL, mail it in an envelope to 73, Wayne Green Inc., 70 Route 202-N, Peterborough, NH 03458. Attn: QSL of the Month. Winners receive a one-year subscription (or extension) to 73. Entries not in envelopes cannot be accepted.

I'm not sure what the benefit is of nets where dozens to hundreds of ops check in to the net control and report they have no traffic. You can't talk with dozens of people. Oh, you can lecture them, but that isn't talking. Nets have the benefit of convincing thousands of hams that they're doing something. The upside of nets is that at least they seldom require anyone to think.

So? So what can you talk about? Well, if nothing else you might ask 'em if they've read the latest baloney in my editorials. I cover all sorts of topics, so you can rip me apart on about almost anything. You are always telling me that you don't agree with everything I write. Okay, put your big mouth where your pen is and tell the next chap you are in contact with what you disagree with and why. Tell 'em what you think of Wayne's pontifications.

I'm Stupid and Ignorant

Tell 'em you think I'm stupid and ignorant for suggesting that our public schools are destroying our kid's minds. Tell 'em what a lousy thing I did when I started pushing for a no-code license a few years ago and how amateur radio has gone to hell in a handbasket as a result of this accursed new license. Tell 'em how repeaters have screwed up hamming and I never should have promoted 'em back in 1969.

If you're short of mud to throw at me, I'll be glad to wet down your adobe hacienda so you can have more ammunition. Half of you will absolutely hate my pro-choice thoughts. The religiously overwrought will go bananas over my ideas on religion and have enough to talk about to keep them going for a generation. But hey, you've never asked me about God, Christ, Mohammed, Sri Krishna, Smith, Moroni, and Amee Semple McPherson. There are whole new fields of controversy to blow out of proportion.

We aren't short of groups looking for fights. There's feminism, homo-ism, cripple-ism, a wide range of religious fundamentalisms, a few political-isms. Oh yes, racism. So if we can't have intelligent conversations over the air, perhaps we can at least vent our bigotries and non-thinking prejudices, perhaps building up more steam than we can let off.

"This usually brings a letter telling me how stupid and opinionated I am."

The upside of this is that when people get angry they louse up their immune system and are open to all sorts of both long- and short-range illnesses. Short-tempered people tend to be sicker and shorter-lived, so we don't have to deal with them for as long.

When you run into an angry, sarcastic person over the air you can sign off and change frequencies. But pity his family and business acquaintances who have to live with this poison! I get letters from angry people. Not many, but a few. That's natural because I write what I think . . . always with the proviso that if you disagree I want to hear why you disagree. Angry people don't have any whys, just vehemence. I often waste my time trying to answer their angry letters, explaining why I've come to the conclusions I have. This usually brings another letter telling me how stupid and opinionated I am. Sure, I'm opinionated, but at least I've done a lot of homework before arriving at my opinions.

Using Edison's definition of genius, mine is 99% perspiration and 1% inspiration. But you know, after the 99% perspiration, that little 1% of inspiration is very exciting and makes the perspiration more than worthwhile. So I keep buying books which are recommended as being worthwhile and reading them, highlighter always at hand. I keep a growing clip file of ideas from magazines. I find the most interesting people I can to discuss ideas. I'd love to run into you on 10, 15, or 20m and find out what you've done that we can talk about. But if all you're after is a crummy New Hampshire QSL you can go jump in a lake.

You probably aren't going to run into me during contests. I've done contests. I've done all the contests. I've worked all the countries I ever want to work, so I don't need any more QSLs. I've thrown out more certificates than 99% of you have collected, so I don't need any more certificates. No, when it comes to hamming, I mostly like to have conversations.

Oh, it's fun to make contacts via the satellites, even though some of them don't support long conversations. But having done that and earned a bushel of QSLs in the process, I don't seem to find myself driven to get my station set up again for OSCAR.

Satellite contacts are something I recommend everyone try. But the contacts tend to be more like a contest and after awhile the fun wears thin. Few of us other than true-blue DXers enjoy an endless contest.

Heck, after DXing from over 50 countries, I don't seem to be as interested in working the pile-ups from rare spots as I used to. Oh, that was tons of fun and I'll never forget one minute of any of my trips. But I've *done* that, and don't seem to be as readily volunteering for the hardship duty that goes with many DXpeditions. Besides, it's time I got you to get out there and have the fun.

Maybe you can practice up a bit before we make a contact. Maybe you can try to break that habit of not actually talking over the air. How about trying some contacts where you do not mention your equipment . . . not even your antenna. Keep your signal report to just readability. I do want to be sure you can hear me when we're talking. I'll bet you'll find this a serious strain on your ingenuity at first.

Remember, the more you get the other chap to talk, the more interesting the contact is going to be for him. He'll never notice that you aren't talking much, but are mainly asking him questions about him. All he'll know is that he's had more fun during this contact than he's had in ages.

However, when we contact you should do most of the talking. Remember, I've been sharing my joys and disappointments with you via my editorials, so now it's your turn to tell me about you. 73

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Continued on page 83

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NEW PRODUCTS

Continued from page 78

RAI ENTERPRISES

"Quickyagi" from RAI Enterprises is an inexpensive and easy-to-use yagi modeling/optimizing program that is both fast and accurate, and is used by antenna manufacturers, universities, government agencies and amateurs worldwide. "Quickyagi" utilizes a highly intuitive user interface with fully prompted functions, single key stroke menus, and scrolling highlight data access. Designed for nontechnical as well as technical users, it utilizes a unique auto-design function. The user only needs to input the desired frequency of operation, the number of directors, and the element diameter(s), and the program will automatically design and optimize a yagi, with a choice of optimum F/B ratio or optimum gain at the selected front-to-back ratio, while attempting to maintain minimum side-lobe levels. Other options include a bandwidth optimizer with a choice of wide or minimum frequency bandpass and pattern bandwidths. The auto-optimizing function may be used separately to optimize existing yagi designs.

"Quickyagi 2.5" is priced at $37, plus shipping and handling. For more information, contact *RAI Enterprises, 4508 North 48th Drive, Phoenix AZ 85031; (602) 848-9755.* Or circle Reader Service No. 205.

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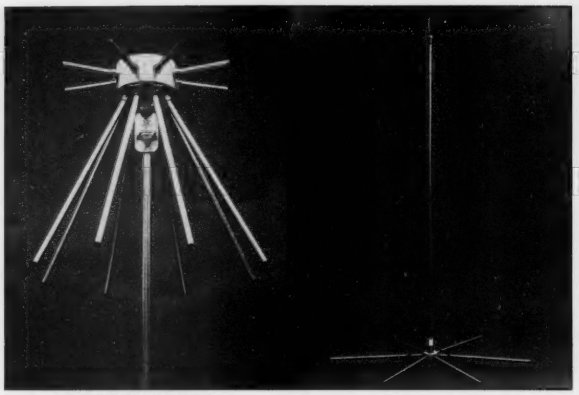
The second edition of *The "Grounds" for Lightning & EMP Protection* is now available from PolyPhaser Corporation. This expanded and updated edition contains 100 pages of information detailing the proper techniques for grounding and the protection of electronic equipment from the destructive energy of lightning and nuclear EMP. The publication's primary focus is on protecting radio communications equipment. Other in-depth protection topics covered are: telephone, central office equipment, computers, local area networks, cable TV, TVRO, and security cameras.

This how-to-do-it publication is priced at $22.95. For more information, contact *PolyPhaser Corporation, Customer Service Department, P.O. Box 9000, Minden NV 89423-9000; (702) 782-2511.* Or circle Reader Service No. 204.



FLYTECRAFT

FLYTECRAFT has introduced two new antenna models, the Model CFN and the SFX line. The Model CFN (left) is a 16-element, wideband VHF/UHF antenna designed for amateur radio operators or scanner enthusiasts, and for all frequencies from 50 through 1300 MHz. It provides a solid low angle of radiation or reception with a low SWR across the spectrum (less than 1.7 to 1 with unity gain). The Model CFN is designed for both indoor and outdoor use, and for permanent or portable use (to assemble, you simply insert the elements and tighten the screws).

The SFX line of monoband vertical antennas (right) comes in five different versions for 40, 30, 20, 15 and 10 meters. These antennas are only nine feet high (the 10 meter model is seven feet) and are designed to sit on a patio, lawn or balcony. They can be set up or taken down in just a couple of minutes, and they are unobtrusive enough for antenna-restricted locations.

The CFN is $119.95 (plus $5.50 S&H); the SFX 40, 30, 20 and 15 are $99.95 each and the SFX 10 is $89.95 (plus $6.50 S&H per antenna). For more information, contact *FLYTECRAFT, P.O. Box 3141, Simi Valley CA 93093; (805) 583-8173, (800) 456-1273.* Or circle Reader Service No. 206.

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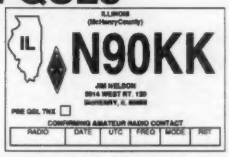

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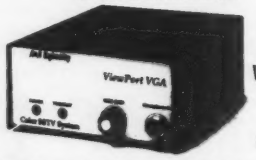
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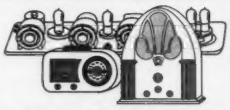
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RANDOM OUTPUT

David Cassidy N1GPH

Why We Were Not at Dayton

As I write this, the Dayton Hamvention is a week ahead. When you read this, the Hamvention will be six weeks in the past. (Kinda' like time travel, isn't it?) I can assume that there are several thousand of you who took note that, for the first time in almost 30 years, *73* did not have a booth at Dayton. Wayne and I were both there—Wayne to give his annual forum, me to walk around and bother people—but we did not have a display booth as we've always had.

I hope those who renew their subscriptions at Dayton every year were able to find one of the several thousand fliers we printed, offering the same deal that we would have offered in person. (If not, just send your Hamvention ticket stub, along with your renewal and $15, to: *73 Amateur Radio Today*/Dayton Subscription, 70 Route 202 North, Peterborough NH 03458. *Do not* send it to the regular renewal address.)

Many of you are probably curious as to why we decided to bypass Dayton this year. There are two main reasons.

Reason #1

We do not go to hamfests to make a direct profit. In fact, if you look at what it costs to attend a show, compared to the actual dollars we take in, you'd think that we lose *a lot* of money at every show we attend. Added to the cost of booth rental, air fare, hotel and meals, is the hidden cost of lost revenue. *73* is a pretty tight ship. We don't have enough staff to send to as many hamfests as we'd like. When I'm traveling to and from a hamfest, I'm not in the office and that can cost the company money in lost productivity. Even more important, every day that an ad sales rep is not in the office is a day of lost sales. I wish I could hire a few people to do nothing but travel to a different hamfest every weekend, but I can't.

Every day spent out of the office is a trade-off. Where the money spent on hamfests *does* pay off is in advertising dollars and public relations. Just being at the show puts us in front of subscribers and potential subscribers. This is good PR. Where the *big* money comes in is in advertising revenue. Hamfests are an opportunity to get face-to-face with our advertisers—to thank the ones who are regular advertisers, and to build a relationship with those who aren't, in the hopes that they someday will become advertising clients. We spend a lot of time on the floor of the convention, just saying "Hi" to our advertisers (and non-advertisers). We also work after the hamfest closes its doors for the night, going to dinner with potential advertisers, working out special promotions, or just socializing. Working a hamfest is usually at least a 12-hour day (and most of that is on your feet), but it pays off. Signing a single advertiser to a 12-month contract for a single page pays for the expenses of attending five hamfests.

The problem with Dayton is that it is so big that we don't get to spend any time with our advertisers. It is so crowded that we don't have a chance to really talk to those who stop by the booth. All we can do is take their money and then say, "Next, please."

Dayton is so expensive to attend that there is no way we can make back the cost. Even though we sell at least 10 times the number of subscriptions we sell at any other hamfest, that revenue doesn't even come close to offsetting the enormous expense of attending. For what it costs to attend the Dayton Hamvention, I can attend five or six other shows, which is a much smarter way to spend an already tight budget.

Reason #2

The other reason we finally stopped throwing money down the Dayton hole is that the Hamvention is, in my not-so-humble opinion (as well as the opinions of many members of the amateur radio business community), the absolute worst-run hamfest of the year. Somewhere along the line, the Dayton Hamvention became a business—a *big* business—and yet it is still managed as if it were a local club event.

The price of a booth at Dayton is over twice the price of a booth at most major hamfests. What do you get for this overly-inflated price? Not much! You get to wait around for hours while the contents of your booth are delivered. You get to pay extra for such basics as a table skirt. You get to spend hours hunting down someone who can answer the most basic of questions. You get to spend the night at a hotel that is probably at least a 30-minute drive from the convention. You get to spend three days in a dirty, smelly and hot building that is nowhere near large enough to hold the number of attendees and exhibitors (every year I wonder where Dayton's fire marshal is). You get to pay extra to staff your booth with enough people to properly run it. You get to wait again on Sunday for the contents of your booth to be "checked-in" before you can leave. In short, after putting over a thousand dollars into the Hamvention coffers (and thousands more into the local economy), you get treated like your business isn't important. The attitude is, "we don't care if you're here or not, because we'll still make gobs of money without your business."

Speaking of money, I've often wondered where all that money goes. There are 657 exhibitor spaces at Dayton. Each one of those spaces costs at least $425. For some strange reason, Dayton is the only place I know of where a second booth space costs *more* than the first. For the sake of simplicity, let's say every booth sold for the single booth price. That's $279,225 just for the inside booths. There are roughly 4,350 flea market spaces, each selling for between $30 and $50 each. Let's split the difference and say the average space goes for $40. That's another $174,000. Each one of those spaces has at least one person, and that's an additional $11 each. Add another $47,850. Paid attendance has been over 30,000 for several years, but let's use that as a

Continued on page 61

Number 29 on your Feedback card

PROPAGATION

Jim Gray W1XU

Jim Gray W1XU
210 East Chateau Circle
Payson AZ 85541

The HF bands this month are expected to provide a mixed bag of conditions. The summer solstice occurs while the sunspots continue their steady decline, as evidenced by the Solar Flux data given by WWV at 18 minutes past each hour.

You may expect the best days (G) on the 5th, 10th, 18th, and 30th . . . give or take a day or two. The worst days (VP) are likely to occur on the days from the 21st to the 27th, when conditions are very likely to be violently disturbed with active to storm conditions taking place in earth's magnetic field. Signal absorption levels are likely to be very high and DX poor to nonexistent. A full eclipse of the moon will occur on June 4th.

During the period between the 21st and 27th you may also expect some violent weather and other geophysical phemonena. Be aware of the possibility of a hurricane about that time. There may also be some possible earthquakes and volcanic eruptions around those dates. Although such a report is speculative in the extreme, keep a sharp lookout and let me know what you experience at your location. The first day of June is also likely to be very poor (VP) to poor (P), but conditions will rapidly improve.

On Good days and even Fair days you will find *10 and 12 meters* opening out to 1,000-1,500 miles, with very high signal strengths and rapid fades, due to sporadic E-layer ionization. *On 15 and 17 meters*, you will find trans-equatorial DX on Good days with occasional openings on east-west paths peaking during the afternoon hours at your location. Remember, DX travels westward with the sun. The *20 meter band* is likely to be the best DX band during June, with strong conditions on Good days to most parts of the world. Early morning and late afternoon hours are particularly favorable for DX, and you can expect short skip to be strong out to 500 miles or so during the daylight hours. The *30 and 40 meter bands* will give you excellent DX opportunities during the evening, nighttime and early morning hours on Good days, subject to thunderstorm QRN (which certainly can dampen your enthusiasm). Short skip will also be good on this band, often as far as 2,000 miles at night. Midnight DX to Europe and dawn DX to the Orient can be expected on good days. In general, *160 and 80 meters* are not considered to be good bands during daylight hours due to excessive absorption of signals. Occasional DX openings may be encountered on particularly favorable nights, peaking toward sunrise, but high noise levels will tend to be discouraging in the presence of strong weather fronts (see Poor and Very Poor days).

Predictions and forecasts are both an art and a science, so your scribe can be very wrong or very right on occasion, but I'm generally "on the money," so please let me know how these forecasts work for you. See you next month . . . W1XU

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	-	20	-	-	20	20	-	-	-	-	-	-
AGENTINA	20	-	-	-	-	-	-	-	-	10	10/15	15
AUSTRALIA	15	-	-	-	-	-	20	20	-	-	-	15
CANAL ZONE	15	20	20	40	40	-	20	20	10	10	10/15	10/15
ENGLAND	-	-	-	-	-	-	-	15	15	15	-	-
HAWAII	15	20	-	-	40	40	20	20	-	-	-	15
INDIA	-	-	-	-	-	-	20	20	-	-	-	-
JAPAN	-	20	-	-	20	20	-	-	-	-	-	-
MEXICO	15	20	20	40	40	-	20	20	10	10	10/15	10/15
PHILIPPINES	-	-	-	-	-	-	20	20	-	-	-	-
PUERTO RICO	15	20	20	40	40	-	20	20	10	10	10/15	10/15
SOUTH AFRICA	-	-	-	-	-	-	-	-	-	15	15	20
U.S.S.R.	-	-	-	-	-	-	-	-	20	20	20	-
WESTCOAST	20	80/40	80/40	80/40	-	-	-	-	15	20/15	20/15	20/15

CENTRAL UNITED STATES TO:

ALASKA	15	20	-	-	-	-	-	15	-	-	-	15
ARGENTINA	15	20	20	40	-	-	-	-	-	-	10/15	15
AUSTRALIA	15/20	20	20	-	-	40*	40*	-	-	-	-	15/20
CANAL ZONE	20	20	40	-	-	-	-	15	15	15	10	15
ENGLAND	-	40*	40*	-	-	-	-	15	15	15	20	-
HAWAII	15	20	20	20/40	40	40	-	20	-	-	-	15
INDIA	-	-	-	-	-	-	-	20	-	-	-	-
JAPAN	15	20	-	-	-	-	-	15	-	-	-	15
MEXICO	20	20	40	-	-	-	-	15	15	15	10	15
PHILIPPINES	15	-	-	-	-	-	-	20	-	-	-	-
PUERTO RICO	20	20	40	-	-	-	-	15	15	15	10	15
SOUTH AFRICA	-	-	-	-	-	-	-	-	-	15	15/20	20
U.S.S.R.	-	-	-	-	-	-	-	20	15	20	-	-

WESTERN UNITED STATES TO:

ALASKA	15	15	20	20	20/40	-	-	-	-	-	-	15/10
ARGENTINA	15	20	40*	-	-	-	-	-	-	-	10/15	15
AUSTRALIA	15	20	20	-	-	40	-	-	20	-	-	15
CANAL ZONE	20	20	40/20	40/20	-	-	-	20	15	15	15	15
ENGLAND	-	-	-	-	-	-	-	-	-	20/15	20	20
HAWAII	20/15	20/15	40	40	40	40	-	-	20	-	20/15	20/15
INDIA	15	15	15	-	-	-	-	20	20	-	-	-
JAPAN	15	15	20	20	20/40	-	-	-	-	-	-	10/15
MEXICO	20	20	40/20	40/20	-	-	-	20	15	15	15	15
PHILIPPINES	15	15	20	20	40	40	-	-	15/20	20	-	15
PUERTO RICO	20	20	40/20	40/20	-	-	-	20	15	15	15	15
SOUTH AFRICA	20	-	-	-	-	-	-	-	-	15	-	-
U.S.S.R.	-	-	-	-	-	-	-	20	20	-	-	-
EAST COAST	20	80/40	80/40	80/40	-	-	-	-	15	20/15	20/15	20/15

*Np-Meters possible on good days only

JUNE 1993

SUN	MON	TUE	WED	THU	FRI	SAT
		1 P	2 P-F	3 F	4 F-G	5 G-F
6 F	7 F-P	8 P-F	9 F-G	10 G	11 G-F	12 F-P
13 P	14 P	15 P-F	16 F	17 F-G	18 G	19 G
20 G-F	21 F-P	22 P	23 VP	24 VP	25 VP	26 VP
27 P	28 P-F	29 F-G	30 G			

"The FT-416 comes in black – or gray!"

"New sculpted design, built-in VOX, back-lit DTMF pad, Yaesu's "Straight A's"! Wow!"

"Yaesu did it again!"

FT-416/816
2-Meter/70cm Handheld

- Frequency Coverage
  FT-416:130-174 MHz RX
  140-150 MHz TX
  FT-816:430-450 MHz RX/TX
- 41 Memories (Odd splits on any channel)
- 4 TX Power Levels
  w/FNB-25 2.0, 1.5, 1.0, 0.5W
  w/FNB-27 5.0, 3.0, 1.5, 0.5W
- CTCSS Encode/Decode
- ATS, Automatic Tone Search
- ATT, Advanced Track Tuning
- ABS, Automatic Battery Saver
- APO, Automatic Power Off
- Direct 12V DC Input (5 Watts Output) 5 Watts w/FNB-27 Battery
- Back-lit Keypad and Display
- DTMF Paging and Coded Squelch
- Built-in VOX
- **Accessories:**
  Compatible with most FT-530 and FT-415 Series accessories. Selected batteries in gray.

In great design "form follows function." Only then does breakthrough design evolve. Our new generation of HTs exemplifies this with the exciting FT-416.

An industry first, a choice of colors – traditional black or new-age gray, and a dynamic ergonomically sculpted case that fits your palm like a friend's handshake are only the beginning. New ridged Control Knobs with numbered VOL insure perfect tuning. And, there's a new molded PTT with functions so perfectly aligned they respond to the slightest thumb flex.

Packed with features, the FT-416 has built-in VOX, four-way scan, the largest, brightest DTMF key pad in its class and Yaesu's famous "Straight A's": ATS – Automatic Tone Search, ATT – Advanced Track Tuning, ABS – Automatic Battery Saver and APO – Automatic Power Off. And, Power Output up to 5 Watts.

During testing amateurs found this newest evolution in design remarkably unique. "You have to try it to believe it!", they said. So we invite you to do just that. Contact your Yaesu dealer today and find out what true evolution in design means to you.

FT-416 choice of black or gray
FT-816 black only

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*Performance without compromise.*SM

The newest evolution in design.

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Specifications subject to change without notice. Specifications guaranteed only within amateur bands. Some accessories and/or options are standard in certain areas. Check with your local Yaesu dealer for specific details.

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